HAND SAWS.

HODGSON.

HAND SAWS.

THEIR USE, CARE AND ABUSE.

HOW TO SELECT, AND HOW TO FILE THEM.

Being a Complete Guide for Selecting, Using and Filing all kinds of Hand-Saws, Back-Saws, Compass and Key-hole Saws Web, Hack and Butcher's Saws; showing the Shapes, Forms, Angles, Pitches and Sizes of Saw-Teeth suitable for all kinds of Saws, and for all kinds of Wood. Bone, Ivory and Metal; together with Hints and Suggestions on the Choice of Files, Saw-Sets, Filing Clamps, and other Matters pertaining to the Care and Management of all Classes of Hand and other Small Saws.

THE WORK IS INTENDED MORE PARTICULARLY FOR OPERATIVE CARPENTERS, JOINERS, CABINET-MAKERS, CARRIAGE BUILDERS, AND WOOD-WORKERS GENERALLY, AMATEURS OR PROFESSIONALS.

ILLUSTRATED BY OVER SEVENTY-FIVE ENGRAVINGS.

BY

FRED. T. HODGSON,

AUTHOR "THE STEEL SQUARE AND ITS USES," "THE BUILDER'S GUIDE AND ESTIMATOR'S PRICE BOOK," "PRACTICAL CARPENTRY," ETC., ETC.

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PREFACE.

Of late, much has been said and written concerning saws of all kinds, but the nature of the subject, and the high price of the works relating thereto, have placed most of the information beyond the reach of the persons who would be most likely to profit by the knowledge; namely, the operative mechanic.

It is intended, in the work now offered, to impart such information on the subject of Hand Saws, and to put it in such a shape that any mechanic who is anxious to obtain and understand it, may do so with a minimum of outlay, and thus secure at little cost what could not otherwise be obtained without an expenditure that few workmen would care to afford.

The information offered in these pages will consist more of a collection of facts and theories than of original matter, and these facts will be the chief recommendation, for there can be little said on the subject at this late day, of sterling value, which does not contain more of the results of former experience than what, strictly speaking, is entirely original. At the same time, the writer's own experience and practical observations will be directed with a special view to give not merely the weighty opinions and practice of others, but also to add, in some degree, to the general stock of information, and to facilitate its acquirement.

It will be impossible, without encroaching too much on space, to give an authority for every illustration or quotation made use of; it is but just, however, that the chief sources from which they are drawn should be given, so as to enable the reader, if he so desires it, to pursue the subject beyond these limits. It is only fair, also, that the labors of the toilers in this field, who have written before, should receive due recognition, and with these ends in view, I take pleasure in mentioning the following works, from which I have drawn to a greater or less extent for a majority of the rules and hints herein set forth.

I am indebted in a great measure for the historical portion of the work to Wilkinson's "Egyptian Antiquities," "Beckman's History of Inventions," and "The Cantor Lectures." For the practical notes I have drawn largely from the following sources: "Worssam on Mechanical Saws," "Emy's Traité de l'Art de la Charpenterie," "Holtzapffel's second vol. of Turning and Mechanical Manipulation," "Knight's Mechanical Dictionary," "Transactions of the Society of Engineers, London," "Encyclopædia Britannica," "Iconographic Encyclopædia," *Scientific American*, *English Mechanic*, *Engineer*, *The American Builder*, 1876, Richard's "Wood-Working Machinery," and "Grimshaw on Saws."

That a cheap work like this one, on the subject of hand-saw filing, is wanted, every workman knows, and knowing this myself, I have endeavored to supply the want in the following pages, and leave it to those for whom the work is designed to adjudge whether I have succeeded or not.

THE AUTHOR.

New York, 1883.

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HAND SAWS.

PART I.—A BRIEF HISTORY OF THE SAW.

THE SAW must have been known at a very remote period, in some shape or other, for the gorgeous and magnificent structures of the ancient world could never have been formed without some knowledge of its use and management; but the extent of that knowledge, and the modes of its practical application, cannot be deduced from the insufficient data at our command.

There is not the slightest doubt but that the first saw was a very imperfect instrument in comparison to those now in use.

The ancient Greeks ascribe the invention of the saw—as also the chisel, compasses, auger, etc.—to Dædalus, or his disciple, Perdix, renowned architects and sculptors, who were accustomed to employ these instruments in the production of wooden images of the gods. There is every reason to believe, however, that the invention of saws was infinitely more remote, as they have been discovered, clearly represented, in the midst of the hieroglyphics on the obelisks of Egypt.

In the British Museum there are several bronze saws that have the stamp, or arms, of Thotmoth the second, king of Egypt, who lived about two thousand years before the Christian era; perhaps these are the oldest saws known to exist at the present time.

The great antiquity of saws can be accounted for in the fact of their being a simple thing, considered as a mechanical expedient, and in the necessity of having them to carry on the simplest operations in wood-work. "Necessity has," as expressed in the old

adage, "been the mother of many useful inventions;" and a serrated plate of metal to divide wood, or other material, without destroying any considerable part, must have become, very early indeed, a necessity.

That saws were so invented is in a measure proved by the fact, that just as soon as the necessity was supplied, invention stopped, and down through ages, the reciprocating saw was used without the idea of a revolving plate with a continuous action having been entertained.

The saw, being the only instrument by which wood, ivory and various other substances can be converted with profit and satisfaction to the dimensions required in the industrial arts, it must have naturally held a place of exalted importance among the artisans of the early ages.

Saws are mentioned in Holy Writ in several places; particularly are they mentioned in Samuel (1033 B. C.) and Isaiah (742 B. C). And in an old Jewish work, entitled "The Ascension of the Prophet Isaiah," the following sentence occurs: "Then they seized Isaiah, the son of Amos, and sawed him with a wooden saw." And again, "Neither did he cry out or weep, but continued to call on the Holy Ghost until he was sawn asunder." St. Paul, in speaking of the early martyrs, says, "They were sawn asunder."

Saws of the bronze age have been discovered in Germany and Denmark. The blades were very thin, and the teeth were probably chipped or ground in. Saws of the stone age were made by setting flakes of flint in wooden handles, and securing them with bitumen. Obsidian—a glass-like mineral—was used in Mexico. Saws and knives of Obsidian have been found in the alluvial deposits of New Jersey, beneath the recent gravel.

The saws of the South Sea Islanders, in 1768, when Captain Cook visited Otaheite to observe a transit of Venus, were made of sharks' teeth lashed to a back piece. The saws of the Lacustrians and other early inhabitants of Europe were of jagged flint; those of the Caribs of notched shells.

Among savages the saw was but little known, for without files or other instruments to keep it sharp it soon becomes useless. The

knife and hatchet, being more barbarous weapons, could readily be sharpened on a stone; but to sharpen a saw is quite another affair.

The ancient Egyptian saw-blade was of bronze, attached to the handles by leathern thongs, and was single-handled. Some of the blades, however, as in the instances of some of the Egyptian saws in the British Museum, are set into the handles with tangs, like our case-knives. The Egyptian saws were operated by the thrust movement, the edge curved or straight. Such are shown in the paintings of ancient Egypt.

St. Jerome is understood to have alluded to circular saws in his writings, but the point is not clear.

A double-handled iron saw has been discovered at Nimroud.

Sesorthus was called Aslepius by the Egyptians on account of his mechanical skill. The Greeks derived from him the name and attributes of Æsculapius. He introduced into Egypt the art of building with hewn stone, and, it has been supposed, used saws upon his blocks of stone. This is by no means certain, but we are told distinctly in the Hebrew history that the Phœnician architects of Solomon's temple built it of stone squared with the saw. The marble facing of the palace of Mausolus, king of Caria, described by Vitruvius, is believed by Pliny to have been faced with sawn slabs. This was erected 350 B. C.

The stone saws were commonly used, and the respective actions of the metal and sand were fully understood, in the time of Pliny.

Japanese saws are shaped like butchers' cleavers. The handle is flattish, as if whittled out of a piece of inch board; the shank of the saw is driven into the handle, and the whole is secured by being wrapped with fine split cane. The metal of the saw is about the substance of our saws, but the teeth are narrower, giving more of them to an inch, and much longer. The teeth are pointed toward the handle. When a Japanese wants to rip a plank, he places it across anything which will elevate the end a few inches, then stands on the wood and cuts it by seizing the cleaver-looking saw in both hands, and pulling it toward him, working it by short, quick up-strokes.

The very distinguished place occupied by General Sir Samuel

Bentham in the history of the invention and manufacture of wood-working machines is evinced by the list of sawing-machines invented and manufactured by him for the British Admiralty previous to 1800.

Circular saw.
Segmental circular saw.
Crown and cylinder saws
Segment sawing-machine with radius arm.
Saw for irregular forms with tracer-guide.
Bevel saw.
Curvilinear saw.
Saw-blade grinding-machine.
Taper-gage for sawing-machines.
Double-grooving saws.

The circular saw is well described in Miller's English patent, No. 1,152, of 1777.

The band-saw is described in Newberry's English patent, 1808, to which is attached a drawing showing a band-saw, with frame and pullies very much like those used at the present time.

In the annexed illustrations, some idea of the forms and the manner of using saws by the ancients may be gleaned by the reader. Fig. 1 is taken from a painting on a tomb at Thebes; *a* shows how the stuff to be sawn was made solid while the operation of cutting was performed.

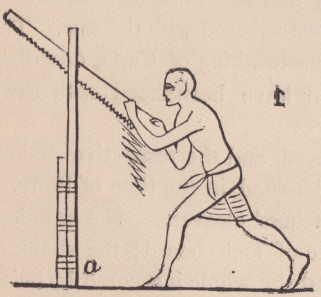

Fig. 1.

Fig. 2 shows a workman using a sort of a bow-saw. This is also Egyptian. It will be seen that the shape of the bow does not vary much from the saw-stretching frame used by the celebrated Boule, whose fine sawing and inlaid work were so famous a century or so ago. Fig. 3 represents two genii working a frame saw; it is taken from a painting at Herculaneum. Fig. 4 is a frame saw, from a funeral monument. Fig. 5 is a frame saw-blade detached. Fig. 6 is an Egyptian saw, now in the British Museum, and is supposed to be the oldest saw in existence; it is of bronze, and is 3-16 thick on its serrated edge, and

less than 1-16 on its back edge; it is fastened with a handle of acacia wood, by thongs of hide and rivets. Fig. 7 represents a group of workmen making chariot tongues or poles; this is from an ancient painting at Thebes.

Fig. 4. Fig. 6.

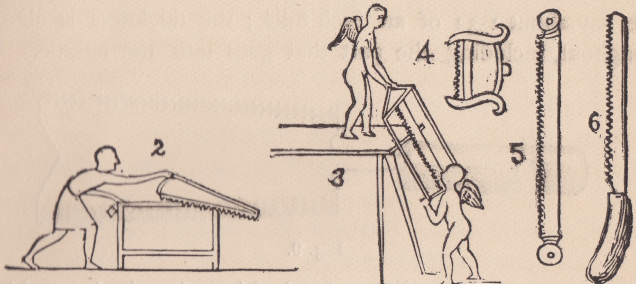

Fig. 2. Fig. 3. Fig. 5.

One man in the drawing seems to be sawing a piece of stuff preparatory for the other workmen.

Fig. 7.

The Assyrians have left us but few representations of the saw, owing, no doubt, to their being a more aristocratic people than the Egyptians, with whom skilled mechanics were acknowledged a power in the state. Fig. 8 represents an Assyrian saw. It is two-handled, and intended, no doubt, to be operated by two workmen. This fact shows that a proper knowledge of the saw was advancing. All Egyptian saws, so far as can be known, were operated by one person only; and,

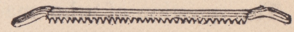

Fig. 8.

unlike the modern Japanese saws, the point of the tooth *pitched from* the operator. In the Assyrian saw the tooth is arranged to cut both ways.

Fig. 9 is a modern Japanese saw; it has a blade about 8 inches long, and of a thickness of the thin end of an ordinary dinner knife, say about 1-32 of an inch thick; the thickness is alike all throughout, including the part that goes into the handle. It is

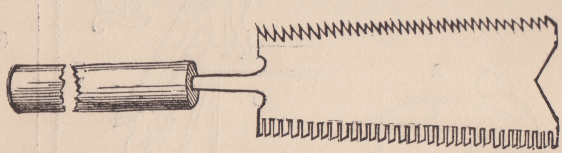

Fig. 9.

held in the handle by a wedge that is driven into it along with the tine of the saw-blade.

Fig. 10 is another Japanese saw, nearly the same size as Fig. 9.

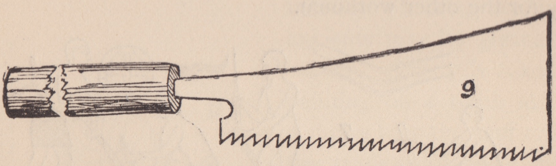

Fig. 10.

This is a rip saw, and the reader will notice that all the teeth point to the handle. This is a characteristic of all Oriental saws. The square tooth in Fig. 9 is adapted for cutting both ways.

The circular saw is, comparatively speaking, a modern institution, and has been brought to its present state of perfection within the memory of many now living.

The question of who made and used the first circular saw in America, is involved in considerable doubt. Knight, in his "Mechanical Dictionary," says that "a circular saw was made with blacksmiths' tools by Benjamin Cummins, at Bentonsville, N. Y., about 1814. This is supposed to have been the first made in this country.

The writer has had convincing evidence placed before him, that a circular saw was made from a piece of steel intended for a shovel blade, by a wagon maker in the town of Pawtucket, R. I., at an earlier date than 1814. The saw was in use for many years, and was the wonder of the neighborhood for a long time. At the close of the war of 1812, an importer in Pawtucket received a consignment of circular saws from England, where they had been in use for many years previous. There is some reason to believe, however, that circular saws had been used in Baltimore and Philadelphia at least a dozen years before the war of 1812. Circular saws of a crude kind had been in use in England many years before Bentham patented his perfected saw; and the frequent intercourse between the people of this country and England would bring to light the fact of its existence. And the pre-Revolutionists were not so dull as to not see the advantages of introducing circular saws in a country so pre-eminently "woody" as this was in those days.

PART II.—RULES FOR SELECTING HAND SAWS.

A MECHANIC of considerable skill was once asked what the difference was between a rip and a cross-cutting saw. The answer was ready enough : "Why, in the shape of the teeth, and the manner of filing them." A second question followed: "*Why* are the teeth of different shape for ripping and cross-cutting?" This question was never answered. The mechanic knew by accident that some teeth required to be of different shape for different purposes; he had long acquired this knowledge by observation and experience, but had gone no farther. His education in the matter had required years, had involved experiments, mistakes, and no end of annoyance, all of which might have been avoided by a proper application of the laws that govern cutting and abrading tools.

The various operations performed in working wood consist either in dividing it into parts, or in giving shape to such parts after they are divided. The first operation is performed by means of saws; the second by cutters. So far as a principle of operating, there is no difference between sawing and cutting; both processes remove portions of wood until the desired end is accomplished. It is to the cutting action and form of saw teeth, however, with which we have to deal at present, and not with other modes of cutting.

In the form of teeth for rip saws there are several conflicting conditions to contend with. The cutting action, if that alone were to be considered, would call for one form of teeth ; while to contain the set or clearance of teeth, demands another, and a different shape ; while, to provide room for the sawdust cut away may call for a form and arrangement of teeth different from what either cutting or setting suggests; so that a kind of compromise betweeen

the forms demanded by these different conditions is the best that can be done.

A rip-saw tooth, considered singly as a cutting tool, may be likened to a chisel, and the form of teeth which would operate with the least power would be the same as that of a mortising chisel, shown in Fig. 11; and in every case where clean lumber is sawed, and when long experience has demonstrated what form of teeth operate with least power, there has been an approach to what is called chisel teeth, as shown in Figs. 11 and 12.

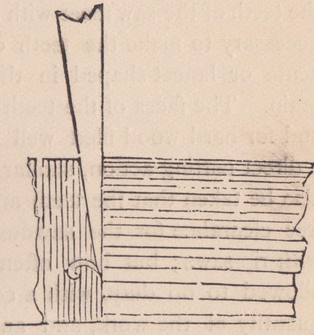

Fig. 11.

Knots and hard wood are conditions which call for rigid teeth, rendering the chisel form impracticable; and it is only in sawing clear lumber, and with a high degree of skill in filing and setting, that such teeth can be employed to advantage.

Fig. 12.

The limit of endurance, with such steel as must be employed for saws, will not permit their pointed teeth; they will break in cutting through knots and hard wood; and whatever besides is taken into account, no form of saw-teeth which permits their points to crumble and break should ever be adopted. In actual practice, with the skilled filer, there is a tendency to create pointed saw-teeth, and when there is a want of skill in the filer the tendeny is the other way, and teeth unnecessarily blunt are common.

The action of a saw when used for ripping or cutting with the fibres of the wood is entirely different from one used for cross-cutting or severing the fibres of the wood transversely; the shape of the teeth and the method of sharpening should be therefore entirely different. In the case of a rip-saw the action of the

saw is chiefly a splitting one, the teeth acting like a series of small wedges driven into and separating the longitudinal fibres of the wood, whilst with cross-cutting saws the fibre of the wood has to be severed across the grain and is comparatively unyielding, and the teeth of the saw meet with much more resistance, and it is found necessary to make the teeth considerably more upright, and more acute or lancet-shaped in their form, than for cutting with the grain. The faces of the teeth should be sharpened to a keen edge, and for hard wood filed well back, so that in work they may have a direct cutting action, similar to a number of knives. Care should also be taken that the teeth are made of sufficient depth to afford a free clearance for the sawdust. This is an important point also with rip-saws; but how often do we see stumpy, ill-shaped teeth, allowed to do duty, with a corresponding loss in the quality and quantity of the work, and an increase in the labor used? The teeth should also be equal in length; if not, the longest teeth get the most work, and the cutting power of the saw is much lessened. The length of the teeth should depend on the nature of the wood being sawn; for sawing sappy or fibrous woods, long, sharp teeth are necessary, arranged with ample throat space for sawdust clearance; care must be taken, however, that the teeth are not too long, or they will be found to spring and buckle in work. In sawing resinous woods, such as pitch pine, the teeth of the saw should have a considerably coarser set and space than for hard woods. It will also be found advisable—especially with circular saws—to lubricate the blades well, as the resinous matter is thus more easily got rid of.

In sawing hard woods, either with reciprocating or circular saws, the feed should be not more than one-half as fast as for soft wood; the saw should contain more teeth, which should be made considerably shorter than those used for soft wood, roughly speaking about one-fourth; it is impossible, however, to make a fixed rule, owing to the great variety of woods and their different hardnesses; the length of the teeth which may be found to suit one wood well may in another case require to be increased or decreased.

In cutting woods which are much given to hang and clog the saw-teeth, increment teeth may be used with advantage; these are

arranged with fine teeth at the point of the saw, which gradually get coarser till the heel of the saw is reached: thus the fine teeth commence the cut and the coarser ones finish it, thus obviating in a great degree the splintering and tearing of the wood caused by coarse teeth striking the wood, at the commencement of the cut.

As regards the angles of the teeth best adapted for cutting soft or hard woods no absolute rule can be laid down. The following, however, may be given approximately, and modified according to circumstances. If a line be drawn through the points of the teeth, the angle formed by the face of the tooth with this line should be: For cutting soft woods, about 65° to 70°; and for cutting hard wood, about 80° to 85°. The angle formed by the face and top of the tooth should be about 45° to 50° for soft wood, and 65° to 70° for hard. It will thus be seen that the angle of the tooth found best for cutting soft woods is much more acute than for hard.

So that no confusion may exist as to the terms used in describing the parts of a saw, we may give the following brief explanation:—*Space.*—The space is the distance from tooth to tooth, measured at the points. *Pitch.*—The pitch of a tooth is the angle of the face of the tooth up which the shaving ascends, and not the *interval* between the teeth, as with the threads of a screw. This is also the rake of the teeth. *Gullet.*—The gullet, or throat, is the depth of the tooth from the point to the root. *Gauge.*—The gauge is the thickness of the saw, and is generally measured by what is known as the wire gauge. *Set.*—The set is the amount of inclination given to the saw teeth in either direction to effect a clearance of the sawdust. *Rake.*—The rake of a saw is the angle, or "lead," to which the teeth are inclined. *Points.*—Small teeth are reckoned by the number of teeth points to the inch.

The chief points to be borne in mind in selecting a saw with the teeth best suited to the work in hand are the nature and condition of the wood to be operated on. No fixed rule can, however, be laid down, and the user must be guided by circumstances. All saws should be ground thinner towards the back of the saw, as less set is thus necessary, the friction on the blade is reduced, and the clearance for sawdust improved. Care should also be taken that

they are perfectly true and uniform in toothing and temper. The angle of the point of a tooth can be found by subtracting its back angle from its front, and to do the best and cleanest work this angle should be uniform in all the teeth of the saw.

The following table refers strictly to such saws as are generally used by mechanics who work wood by hand.*

Names.	Length in Inches.	Breadth in Inches.		Thickness in Inches.	Teeth to to the Inch.
		At Handle.	At End.		
Without Backs.					
Rip saw	28—30	7—9	3—4	0·05	3½
Fine rip saw	26—28	6—8	3—3½	0 042	4
Hand-saw	22—24	5—7½	2½—3	0·042	5
Cut-off saw	22—24	5—7½	2½—3	0·042	6
Panel-saw	20—24	4½—7½	2—2½	0·042	7
Fine panel-saw	20—24	4—6	2—2½	0·035	8
Siding-saw	10—20	2½—3½	1¼—2	0·032	6—12
Table-saw	18—26	1¾—2¼	1—1½	....	7—8
Compass or lock-saw	8—18	1—1½	½—¾	....	8—9
Keyhole or pad-saw	6—12	½—¾	⅛—¼	....	9—10
With Backs.					
Tenon-saw	16—20		3¼—4¼	0·032	10
Sash-saw	14—16		2½—3½	0·028	11
Carcass-saw	10—14		2—3	0·025	12
Dovetail-saw	6—10		1½—2	0·022	14—18

Various kinds of teeth are shown at Fig. 13.

a, peg-tooth or fleam-tooth.

b, M-tooth.

c, half-moon tooth.

d, cross-cutting tooth.

e, *slight pitch* or cross-cutting tooth, generally used in small saws; the pitch exceeds that of the former by about 15°.

f, hand-saw, or *ordinary pitch* tooth.

g, tooth having the cutting-face *set forward* at an angle of 15°, used in mill-saws for soft wood.

h, tooth used in some circular saws; also occasionally for pit-saws, cross-cut saws, and saws for cutting soft stone.

* Holtzapffel's "Mechanical Manipulation," Vol. II.

i, shouldered tooth, employed in some rectilinear saws.

j, a similar tooth, having greater pitch; used in circular saws.

k, *l*, *m*, *n*, gullet or brier teeth: the first is better adapted for cross-cutting and for hard woods, such as mahogany; the two next for pit and mill saws; and the last for ripping and for soft woods.

There are other shapes of teeth in use besides these, adapted for various purposes; but, as they are not generally used by the carpenter or cabinet-maker, I shall have but little to say concerning them.

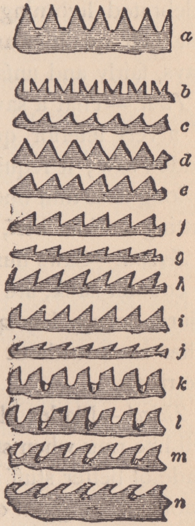

Fig. 13.

Choosing a Saw.—If a hand-saw is not chosen with judgment and care, it may prove a bad one, and in such an event no amount of skill used in filing or setting will ever induce the saw to do good work or give satisfaction in any particular. It requires some skill and knowledge to be able to pick out from a number a saw that will be all that is expected, yet good saws are plentiful enough nowadays, but it is quite astonishing that so few mechanics know what a good saw is. Most of them are governed by prejudice, and will insist in buying saws made by some firm whose saws themselves or fathers had used in days gone bye. A saw should be taken on its merits; there can be no question, however, but that the inexperienced purchaser will certainly fare better by making his choice from among the goods of some noted and reputable manufacturers as few first-class houses permit inferior goods to reach the market.

To aid the purchaser in selecting a saw, the following remarks and hints have been prepared, though it is almost impossible to convey to the reader all the knowledge required to make a sterling selection. Knowing this, I think it better to give the reader the results of some of my own experience. It is some

years now since the following was written, but recent examination of the saws mentioned has only tended to convince me that what I then said holds good now.

I procured a number of saws made by manufacturers in the United States and England, among which we may mention Harvey Peirce, Brooklyn, N. Y.; H. Disston & Sons, Philadelphia, Pa.; Richardson & Co., Newark, N. J.; Spear & Jackson, Buck, Sorby, Taylor & Son, all of England. I also procured one of Boynton's celebrated lightning saws along with the rest. My object was to test their qualities and capabilities; and after using them in various ways, fairly and unfairly, I arrived at the following conclusions:

First.—That a saw with a thick blade is, nine cases out of ten, of a very inferior quality, and is more apt to break than a thin-bladed saw; it requires more "set," will not stand an edge nearly so long as a thin one, is more difficult to file, and being heavier and cutting a wider kerf, is more tiresome to use.

Second.—Saws hung in plain beech handles, with the rivets flush or counter-sunk, are lighter, easier to handle, less liable to receive injury, occupy less space in the tool chest, and can be placed with other saws without dulling the teeth of the latter by abrasion on the rivets.

Third.—Blades that are dark in color, and that have a clear bell-like ring when struck with the ball of the finger, appear to be made of better stuff than those having a light iron-gray color; and I noticed, in proof of this, that the thinner the blades were, the darker the color was, and that saws of this description were less liable to "buckle" or "twist." I took an American saw—the thinnest I could obtain—made by one of our celebrated saw manufacturing firms; I bent it in all manner of shapes, put the point through the handle, bent it over and forced the point through the handle on the other side, letting the blade spring back to its normal condition, on each occasion which it did without causing the slightest deviation from truth in the blade. Another saw, made by a noted English firm, but with a blade much thicker than the American-made saw, was tried and tested in the same way, and stood very well until I put the point of the blade through the

handle, when I found that it retained a curve, which all my subsequent efforts failed to take out. I turned the blade in the opposite direction, and put the point through the handle on that side; but to no purpose; for it still assumed the shape it received when first forced through the handle. I finally broke the blade by purposely letting it fall a distance of thirty-two feet, point first, when it struck a plank, into which it cut more than an inch. The saw snapped off about eight inches from the point, and two or three of the rivets in the handle broke off near their necks. I then tried the American saw by letting it fall the same way. The point of the saw entered the plank, and the blade doubled up until the handle struck the plank, the blade assumed the form of an elongated letter s, and the handle shattered to atoms. The blade, however, did not break, but it was terribly buckled and thrown out of shape. It must be admitted that this was a very extreme and unreasonable test, but it convinced me that, as a rule, *thin blades are made of better material than thick ones.*

Fourth.—American-made saws, as a rule, are better "hung" than English ones. And, where beech is used for handles, and the rivets are flush or counter-sunk, all other things being equal, the American make is the most desirable.

Fifth.—Polished blades, although I know that mechanics have a strong prejudice against them, cut freer and much easier than blades left in the rough, and they are less liable to rust.

Sixth.—Saws that ring clear and without tremor, when held by the handle in one hand and struck on the point with the other hand and held over at a curve, will be found to be well and securely handled, but saws that tremble or jar in the handle, when struck on the point of the blade, will never give satisfaction, therefore they should be eschewed by all young mechanics.

The other saws were tested with great care in a number of ways as to their cutting qualities aud their ability to stand hard usage, and in nearly every case I found the native article able to maintain its own against the imported goods.

Till within the last twenty years there was a decided preference by workmen for English-made saws. This was quite natural, for

England has for a century or more enjoyed a monopoly of the saw trade, and her reputation for the manufacture of all kinds of tools was world-wide, and the names of Buck, Sorby, Taylor & Son, and Spear & Jackson, have been known for many a long year, all over the world, as the best of saw makers. Year after year, however, these makers have lost ground on this continent, and, in fact, in many other parts of the world; for workmen are discovering that American makers produce saws as good as, and, in several important particulars, better than their English cousins. Before I close I trust I shall be able to point out a few of the advantages *some* of the American saws have over English ones. It is not my desire, however, nor is it my intention to praise up the wares of one manufacturer more than those of another; but I deem it my duty to collect for this work all the useful information I can, regardless of the source from whence it is obtained. This last remark is made by way of apology for the following directions for choosing a saw, which are taken from a trade circular published by a large manufacturer of saws in this country, and which is probably the best advice that can be given to an intending purchaser:

In selecting a saw, it is best to get one with a name on it that has some *reputation.* If a man desires to purchase a first-class watch, he selects a maker who has attained some reputation. This remark applies with equal force in the choice of a saw or any other tool.

The first point to be observed in the selection of a saw is to see that it *hangs* right. Grasp it by the handle and hold it in position for working. Then try if the handle fits the hand properly. These are points of great importance for comfort and utility. A handle ought to be symmetrical, and the lines as perfect as in any drawing. Many handles are made out of green wood; they soon shrink and become loose, the screws standing above the wood. Handle wood should be seasoned at least three years before being made up. An unseasoned handle is liable to warp and throw the saw out of truth.

The next thing in order is to try the blade by springing it. Then see that it bends regular and even from point to butt in proportion as the width and thickness of the saw varies. If the blade is too

heavy in comparison to the teeth, the saw will never give satisfaction, because it will require more labor than it ought to do to use it. The thinner you get a stiff saw the better. It makes less kerf, and takes less muscle to drive it. This principle applies to the well-ground saw. There is less suction and friction in a narrow true saw than on a wide one. You will get a smaller portion of saw blade, but you save many dollars worth of hard useless labor with very little loss of width of blade.

See that the saw is well set and sharpened, and has a good crowning breast; place it at a distance from you and get a proper light to strike on it, and you can then see if there is any imperfection in grinding or hammering. It would be well to make a cut in some appropriate wood with the saw before purchasing, even if a board had to be carried to the hardware store for the purpose. Saws, when first set, are laid on a stake or small anvil, and each tooth receives one or more blows from a hammer made for the purpose. A high-tempered saw takes three or four blows of the hammer, as the teeth are apt to break out by attempting to set with one blow. This is a severe test, and no tooth ought to break afterwards in setting, nor will it, if the mechanic adopts the proper method. The saw that is easily filed and set is easily made dull.

Frequently complaints are made about saws being too hard; but manufacturers would make them harder if they dared to do so, as a hard saw will do better work and more of it in a given time, will remain sharp a much longer time, and will work easier than a saw that is easily filed and as easily set. Makers, however, will not in-introduce as hard a saw as they would desire, because mechanics will not buy them, owing to the fact that they have not been educated to a more correct method of saw setting than that in general use. The principal point is that too many try to get part of the set out of the body of the plate, when the whole of the set must be got out of the tooth. Setting below the root of the tooth distorts and strains the saw plate. This may cause a full-tempered cast-steel blade to crack, and eventually break at this spot; but it is always an injury, even if it does not break or crack.

Every word of this is sound advice, both as to selection and man-

agement; and, I would further add, that fifty cents or a dollar should never stand in the way in purchasing a saw. A good saw, well filed and set, is a joy and delight to the user; but a bad saw is a bane and a curse to the owner, and tends to ruin his reputation as a workman, and causes him to frequently use language more emphatic than elegant.

Most of the foregoing directions relate more particularly to the choosing of a cut-off or cross-cut saw; but so far as the blades and handles are concerned, the same hints and directions hold good in the selection of all kinds of hand saws. The differences in the various saws will be recognized at a glance by the expert; but the uninitiated will scarcely know the difference between some of the saws at first sight, therefore it is recommended that he examine the table on page 20, describing the various kinds of saws, and also make himself familiar with the shapes of the various teeth, as shown in Fig. 13. A knowledge of these will materially assist in making a wise and good selection.

Rip saws have wider blades, as a rule, than cross-cuts. This has a tendency to keep the saw in a straight line while in operation. It has the coarsest teeth, and the pitch is greater than in other saws. The cross-cut hand-saws have finer teeth and less pitch than rip-saws. Panel-saws have finer teeth than the ordinary hand saws, and are generally thinner than the other saws mentioned.

Back-saws are known as sash-saws, tenon-saws, dovetail-saws, and pad or carcase saws; they only differ in size and the number of teeth they contain to the inch. The general shape of a back saw is shown at Fig. 14.

The blades of these saws are thin, and are generally very finely finished; the handle is affixed to the blade itself with screws, in the same manner as in hand-saws. The back is either iron colored blue, or brass. Nearly all American made back-saws have backs of iron, the brass-backed saws being chiefly imported from England. The back is held upon the blade by its own elasticity or grasp

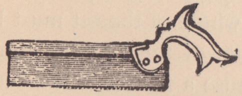

Fig. 14,

alone, and the blade only penetrates about half way into the groove in the back.

The general condition of the blade depends in a great measure upon that of the back, which should not be exposed to rough usage; as a blow on the middle of the back tends to throw the blade more in it at that part, and make it crooked on the edge, a fault that may be in general corrected by tapping lightly on the ends in order to drive the blade as much inwards in those parts as in the centre. When the blade itself is buckled, which is less likely to occur than with hand-saws, from the more careful manner in which back-saws are used, the saw must be taken to pieces and the error corrected by the blade being properly hammered on an anvil.

PART III.—HOW TO USE HAND SAWS.

THE expert mechanic, who knows all about saws that is to be known, will probably think that this chapter is simply a work of supererogation; but when he considers that this work is not intended altogether for those who have a full knowledge of the tool, but rather for those who know but little of it or its uses, he will feel that no apology is due for introducing the following instructions at this point.

In using the rip-saw, the first thing to be considered is the position the stuff must occupy while it is being operated upon. If the stuff to be sawn is board or plank, it will be laid on saw horses or something to take their place, with its face to the horizon, or "flat," and will be sawn with the saw held in an almost vertical position, while the operator places his right knee on the material to hold it firm and solid. If the stuff is thick, say three or four inches, it should be marked or "lined" on both sides, and repeatedly turned and sawn from both sides. This, in a measure, insures good work, and prevents the saw from getting far out of the way. In cutting wide tenons for doors, or other work of a like nature, the stuff is first gauged with a mortise gauge, and then placed in a bench vise, where it is held firmly in an upright position; the saw is then applied in an almost horizontal position, the operator making sure that he keeps the line so that the tenon will not be too thin or too thick. The saw should be finally worked until the line of teeth forms an angle of 45°, and the points touch the further corner on the end of the stuff, and the shoulder on the edge next the operator. The stuff is then turned around, and the opposite edge is brought facing the sawyer, who starts the saw in the kerf already made and works it down until the teeth cut to the shoulder; then the saw is held in an horizontal position and drawn to-and-fro, until the line of teeth touch the shoulder on both edges. If these directions are

closely followed, it will be found that the side of the tenon is, if the work has been properly executed, flat and straight.

Where the work to be ripped out is slightly curved, as in veranda rafters or other similar work, a narrow rip-saw must be used, and the kerf must be kept well open by inserting a wedge of some kind. In ripping plank or tenons, both hands may be used to advantage in guiding the saw, and a very little practice will soon enable the operator to follow the lines with perfect accuracy. In all cases of sawing, the instrument should be grasped in the right hand, and the left may rest on the material, or may be used to assist in the working of the saw. *In the first few strokes the length and vigor of the stroke of the saw should be gradually increased, until the blade has made a cut of from two to four inches in depth, after which the entire force of the arm is employed; the saw is used from point to heel, and in extreme cases the whole force of both arms is used to urge the saw forward. The blade of the saw should occasionally be rubbed with an oiled rag, which would lessen the friction and cause the saw to travel with greater ease.

In most instances, little or no pressure is directed edgeways, or on the teeth; and when the effort thus applied is excessive, the saw sticks so forcibly in the wood that it refuses to yield to the thrust otherwise than by assuming a bow or curved form, which is apt permanently to distort the saw from a right line. The fingers should never be allowed to extend beyond the handle. or they may be pinched between it and the work.

In order to acquire the habit of sawing well, or, in fact, of performing well most mechanical operations, it is desirable to become habituated to certain defined positions. Thus, in sawing, it is better the work should, as often as practicable, be placed either exactly horizontal or vertical; the positions of the tools and the movements of the person will also be then constantly either horizontal or vertical, instead of arbitrary and inclined.

In sawing, the top of the saw-benches should be horizontal or level, the edge of the saw should be exactly perpendicular, when

* Holtzapffel, Vol. II, 1844.

seen edgeways, and nearly so when seen sideways; the eye must watch narrowly the path of the saw, to check its first disposition to depart from the line set out for it. If, however, the eye be directed either so far from the right or left side of the blade as to form a material angle with the line of the cut, the hand is liable, almost unconsciously, to lean from the eye, and thence to incline the saw sideways. It is therefore best to look so far only on the right and left of the blade alternately as to be just able to see the line, and thence to detect the smallest deviation of the instrument at the very commencement of its departure. And then, by twisting the blade as far as the saw-kerf will allow, the back being somewhat thinner than the edge, the true line may be again returned to; indeed, by want of caution, the saw may be made to cross the line and err in the opposite direction. It is, however, best to make it a habit to watch the blade so closely as scarcely to require any application of the correctional or *steering* process at all. The saw, if most set on the left side, or having the teeth standing higher on the left side, cuts more freely on that side, and has a tendency to run or deviate towards the left; and under the reverse circumstances the saw is disposed to run to the right.

Thick stuff should be marked on both sides of the plank, and, as before stated, the stuff should be turned over from time to time, at short intervals, so that a portion of the work is performed from each side; the saw-cut will then assume a series of slight bends, to the right and left alternately, and will depart less from the true line, than if these disturbances had effort from the one side only, and thus produced an accumulating error, or a line swerving in one direction alone, or as a sweep of a large circle. The practice of changing sides with the work will, under most circumstances, be found to lessen the errors incidental to the process, and the practice is therefore especially desirable for beginners.

The work is not always placed on the saw-horses, as in some cases it may be laid on the work-bench, and held down with hand screws or other devices, with the end of the stuff to be sawn hanging over the end of the bench, or the edge of the stuff may hang over the side of the bench so that it may be sawn from end to end.

The workman then stands erect and uses the saw with one or both hands, as the case may be.

The French workman sometimes places his plank on the saw-horses and starts his saw in the wood the usual way, and then he gets behind the saw and sits astride the stuff, and cuts the plank with the saw-teeth pointing away from him. He grasps the saw with both hands, and follows up his work by keeping moving forward after the saw. I have seen Germans use the rip-saw this way with success, and have tried it myself with satisfaction.

The cut-off saw, or cross-cut, is so well known, and the modes of using it so well understood, and its manner of using is so similar to that of the rip-saw, that I need say no more of it at this juncture.

The *Table-saw*, or, as sometimes called, the *Ship-Carpenter's Saw*, has a long narrow blade, and is intended for cutting sweeps or cants having a long radius. Fig. 15 shows the shape and style

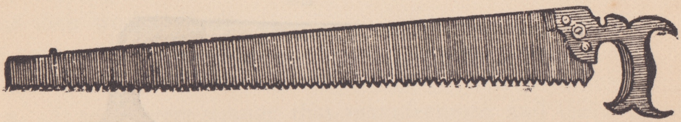

Fig. 15.

of this kind of saw. The manner of using and handling while in operation, is very similar to that of the rip and cross-cut saws.

The key-hole, compass and table-saw are sometimes sold in nests of three blades all nicely fitted to one handle, as shown in Fig. 16. This is an excellent set of saws for workmen to have in their chests, where they are ready for use at a moment's notice; and if I was asked to recommend a set of these saws suitable for the purposes for which

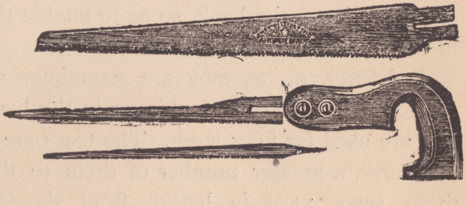

Fig. 16.

they are intended, I should unhesitatingly recommend this set. This is a peculiarly American idea, conceived, no doubt, from the fact that the key-hole or pad-saw handles are so made that saws of any size, within the capacity of the handles, can be placed or removed instantly.

Fig. 17 shows the common compass-saw. The average length of the blades of these saws, is twelve inches, and the width, from an eighth of an inch at the point to an inch or an inch and a quarter at the handle. Saws of this kind very much resemble hand-saws in their general structure and in the forms of their teeth, except that their blades are smaller and narrower, to allow them to lie as a tangent to the curve.

In using this saw great care must be taken, when following a line around curves having short radii, or the saw will kink and buckle, and sometimes break. To prevent these saws from snapping or

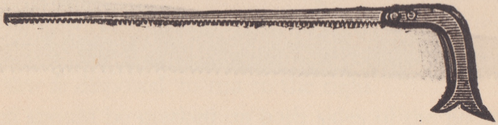

Fig. 17.

buckling, I have frequently filed them so that the teeth would perform the cutting on the pull motion; that is, I have simply reversed the order of the teeth, so that all the cutting would be done when the saw was drawn towards me. Saws of this kind are always ground thin on the back, so as to enable the operator to turn them in the shortest possible curve.

Pad Saws, or, as they are sometimes called, *Socket Saws*, are something narrower and thinner in the blades than compass saws, and are used for finer work. The teeth are also much smaller, and, of course, a greater number of them to the inch. The blades of these saws vary in length from six to fourteen inches, and with teeth from eight to twenty to the inch. At Fig. 18 a socket or pad is shown. The saw is run down the slit or mortise, which goes through the whole length of the handle. The saw is held

solid in place by two set screws. One of the advantages of handles of this kind is, that as much or as little of the saw as may be wanted for the purpose can be left projecting out of the handle for use; the remainder, of course, remaining in the handle. This is an excellent arrangement, as it enables the operator to use any length of saw he wishes, within the limit before referred to. Saws that have been broken, if not too short, may be used again, but if it is the shank end of the saw that is used, the point should be filed rounding, so that it will not catch into the wood, and thereby spoil the work or be broken again.

It is more particularly desirable that saws of this kind should have the teeth so shaped that all the cutting will be done on the *pull stroke*, and it always pays the workman to recut the teeth with a file, making them so that their work will all be accomplished by the return motion of the saw. It seems very strange that manufacturers and users do not recognize this principle in saw making and using. A key-hole saw now in existence, with the teeth so formed that all the work was performed by the *pull stroke*, has been in actual use for over twenty-five years without buckling or kinking, and though worn very narrow and thin, may be used for several years yet. The mechanic owning the saw is a man of brains, and fitted the saw up to suit himself.

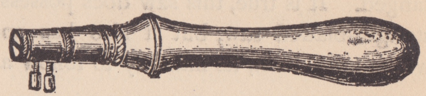

Fig. 18.

Fig. 19 shows a pad-saw with a handle made of cast iron japanned. These are made by a well-known American firm, and answer very well. They are immensely cheaper, and for most purposes are just as useful as the more expensive tool; for the amateur they are just what are wanted.

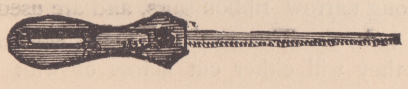

Fig. 19.

Another saw of this kind has recently made its way into the market,

called the "Bush improved compass-saw." The inventor says of it: "The object of this invention is to facilitate the cutting of curved saw kerfs, and consists in constructing a compass-saw of a blade tapered from the centre toward each end, curved transversely, with a curve gradually decreasing in size from the centre toward each end, and pivoted at its centre by a clamping-screw to a handle, grooved upon its opposite edges, so that either part of the blade can be shut into the said handle, according as one or the other part of the said blade is to be used.

The saws are curved and ground in such a manner that they will work free and clear in cutting any reasonable curve, which greatly lessens the danger of breaking or kinking, by pinching fast."

Fig. 19 *a* shows how the saw and blade are constructed and arranged. It is true, this saw does possess some advantages over the straight-bladed saw, but it also has some disadvantages, among which are—First, its inability to follow a straight line as accurately

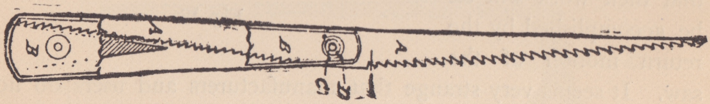

Fig. 19 *a*.

as the straight-bladed saw. Second, the frequent necessity that will arise of taking out the blade to reverse it for cutting curves where the blade must run in different directions. Third, in case of breakage of one end, both ends are rendered useless. Fourth, the necessity of having to take out the screw or rivet to insert a new saw, and screw and rivet anew to fasten in the new blade. The inventor of this saw has also overlooked the fact that all these saws should cut on the *pull stroke*, and has followed in the same old groove of other saw makers, and arranged his teeth to cut on the push stroke.

Web or bow saws are long narrow ribbon-saws, and are used in connection with a frame or bow. The teeth of these saws are generally formed so that they will either cut across or with the grain. Their principal use is for cutting fret and circular work of

all kinds. In these days of jig and band-saws the bow-saw has fallen almost into disuse among carpenters and cabinet-makers; but it is still to be found in some shops, particularly in country places. Fig. 20 shows a very common and useful frame for a bow-saw. This is so arranged that the blade can be disconnected instantly by taking out a little pin that connects it to one of the handles. The object of having the saw arranged this way is to enable the operator to work inside frets or scrolls. This is accomplished by boring a hole through the stuff to be cut, and then inserting the blade, which must be fastened to the handle again with the pin, after which operation, sawing may be commenced.

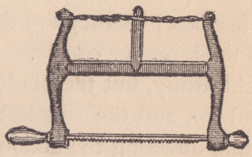

Fig. 20.

The handles on each end of the blade are movable; they may be twisted round so that the teeth of the saw may point towards the cross-bar of the frame. The object of this is to enable the sawyer to adjust the blade to the lines he may be following while sawing. Of course, the blade must always be in a right line and out of twist, while cutting, to insure good work.

The cross-bar of the frame prevents the saw from working in the stuff very far from its edge, thus making it necessary, in cases where the stuff is wide and the work done by hand, to finish the pattern with the pad or compass-saw.

One of the most important of saws is the *Back-saw;* and it is one that requires the best care and attention, though in many cases it receives but little of either. The blades of these saws are made very thin, in some cases not much thicker than tissue paper, as in the dovetail-saw. These saws require but little set, and when they are properly filed and the plates straight and true, the filing generally makes set enough. The *Tenon-saws* and *Sash-saws* being much thicker and stiffer in the blades than the *Dovetail-saw*, will require a *little* set in the teeth; but when kept in good order, the slightest bend of the teeth is sufficient. The tendency of the dovetail-saw to buckle and kink must be guarded against with great

care, for the least twisting of the hand while the saw is in use, or if the saw should stick in the wood and an attempt is made to force it through, the chances are that the blade will be ruined. These saws, also, being so thin, are very difficult things to get in proper order again.

Keep these saws well polished and oiled; for if they get gum or rust on the blades they cannot be worked so easily as when smooth. Where possible, it is best to use these saws in a cutting block or a mitre-box; as they are then less liable to be twisted or forced out of their proper course. In using *back-saws*, the handle should be held firmly, but the blade should be allowed to move with ease to and fro, and the smallest amount of force should be employed while directing the action of the tool. In commencing a cut, the heel of the saw should, nearly in all cases, be placed on the furthest end of the work, and the first stroke should be a pull one. The reason of this must be obvious to every one, as the pull stroke starts a little groove, which the blade will follow more readily when forced in a contrary direction.

It frequently happens that the persons for whom this book is intended, are called upon to file and otherwise put in order that instrument of youthful torture, yclept, a "*Buck-saw*," and in consequence, it will be necessary to have something to say concerning this useful domestic institution. There is no saw, not excepting the one used in the kitchen, that gets such bad usage, and is the subject of so much neglect as the unfortunate buck-saw. Why this should be so is more than I can understand, for there is no tool about a house that is more useful than a good buck-saw. Many a boy has been driven from home—and to ruin—because of a bad, ill-kept buck-saw. I can conceive of no greater punishment than can be inflicted on a lively, ambitious boy than that of forcing him to "buck" wood for an hour or two each day with a saw fashioned like the one shown in Fig. 21. To

Fig. 21.

cut wood with such a saw would ruin the temper of an angel, and had Job been forced to earn his living by cutting cordwood, the probability is that he would not now be held up as a pattern of patience and uncomplaining long sufferance. Yet, how many of us have made the acquaintance of just such saws? How often has our happiness been ruined, and our boyish aspiration checked by being forced to cultivate a knowledge of this ragged, jagged, heart-rending instrument? Now, there is no reason whatever why a buck-saw should not be made to cut as easily and efficiently as any other saw. Indeed, a buck-saw, in good condition and properly

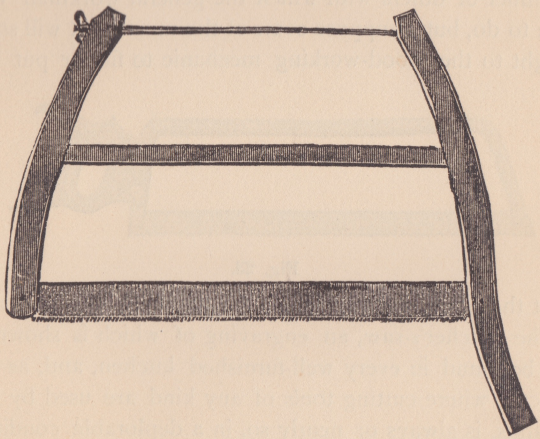

Fig 22.

filed, should cut with greater ease than most other saws, by virtue of its having a narrow blade, and its being kept at a tension that must insure it from buckling or kinking in the wood. Fig. 22 shows what a full-grown buck-saw, in good working condition, should look like. Perhaps some of my readers have seen the instrument in its entirety; indeed, it may be possible that many persons who will buy this book have early recollections of close acquaintanceship with the tool, and the memories are not of the most pleasing nature.

One very important thing in the care of a buck-saw is to keep it dry. Instead of leaving it out of doors exposed to all kinds of weather, after using, it should be hung up in some dry place, and the blade should be rubbed over with a greasy rag to keep it from rusting. Nothing tends to ruin the frame more than leaving it to get wet. The joints get loose and ricketty, and the screw on the straining rod rusts and spoils beyond repair, while the blade becomes almost worthless with rust. A bad saw well cared for may be made to do tolerably good work; but a saw—good or bad—will not work satisfactorily if it is left to care for itself.

Besides the hand-saws mentioned in the foregoing pages, there are a number of others with which the general workman will have but little to do, but I suppose some of the most used will sometimes be brought to the wood-working mechanic to file or put in order.

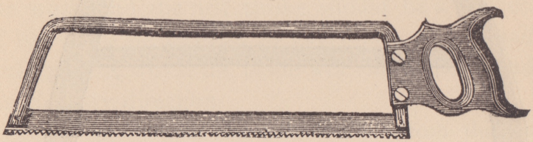

Fig. 23.

Amongst these may be mentioned the butcher's-saw and the hack-saw. The butcher's-saw, an engraving of which is shown at Fig. 23, may be found in every well-furnished kitchen, and, as is generally the case where cutting tools of any kind are used by inexperienced hands, is always or nearly so, in a deplorable condition. It is seldom rusty, but it is generally full of kinks and buckles, and always dull and in bad order, and frequently toothless half its length. It is used and abused for all manner of purposes. The "Hired Help" cuts her kindling wood with it—or tries to—the "boy" uses it to make his sleigh or to cut off a chair or table leg, and cases are known where it has done service as a hatchet. This, like other saws, should be used only for what it was intended, if satisfactory work is expected from it.

The "*Hack-saw*," or *Blacksmith's-saw*, as it is sometimes called, is used for cutting iron or brass. The blade should be hard, and

the line of teeth perfectly straight. Fig. 24 shows one of the best sort of these saws. Like the buck-saw and butcher's-saw, the hack-saw comes in for a great deal of hard usage, but the character of the saw renders it almost invincible, and, though in many cases it would work better if cared for properly, it manages to perform its duties with a fair degree of satisfaction.

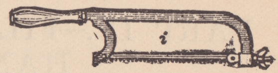

Fig. 24.

PART IV.—FILING AND SETTING HAND SAWS.

THERE is no tool used that is in nearly every case in such bad condition and so little fit to do its work properly as the saw, and all for the want of an easy and sure means to keep it in good order so as to do its work well in the least time with the least expenditure of bodily labor or power. It is a pleasure to do work with a saw when in good order; but it is hard work, and time-killing, to do work with a saw in bad order, and always taxes patience and body to an alarming degree, besides causing much loss of time. A saw in good and proper order will do more and better work in one hour than a bad one will in three.

When a saw cuts the fastest, the smoothest, and makes the least waste, with the least possible labor, it may then be considered at its best. That saws can be made, are made, and will continue to be made, to accomplish all this, is well known to persons who have made a study of mechanical saws; yet to make a saw do this, it is quite necessary that each tooth should be in a condition to do its full share of the work, and not leave for another tooth or set of teeth the amount of labor to do which is its alloted portion. A tooth, badly filed or badly set, not only does no work itself, but it impedes the action of other teeth, and thereby lessens the efficiency of the whole saw. It is a very important matter, then, to have a saw not only straight, and the line of points *true* on the edge, but the line of points on both sides of the saw should be equal and *true.* For a rip-saw, the points of the teeth should be trued with a straight-edge, as I have found, in my experience, a rip-saw doing more work, with greater ease, straight, than either "rounding" or "hollow" on their cutting edge; some good workmen, however, prefer their rip-saws slightly "hollow;" but not more than one quarter of an inch in the length of the blade.

Any person who undertakes to file a saw—no matter what kind of a saw it is—will find it impossible to make a good job of it without exercising as much care as he would in doing the finest kind of joiner or cabinet work; indeed, it may be said that there is no branch in wood-working requiring greater care than that of saw filing, and so well is this understood in some large shops, that one man—a good hand at saw filing—is employed for that purpose, and who performs no other duties. The writer well remembers being in a carpenter's shop in New York, more than thirty years ago, where just such a man was employed, whose special duty was to keep all the saws in the shop in good order, and to see that all the moulding, bead and sash planes were in the best of trim. It is needless to state that both the employer and the employed were benefited by this arrangement; for one had greater service *done* more satisfactorily, and the other *did* more service with greater ease. It is well, however, to remember that thirty years ago wood-working machinery was in its infancy, and circular and band-saws were little used, and consequently the hand-saw was more used than now.

Care is the first requisite in saw filing; without it no person can become an expert filer. I have known men who have been but a few months in a workshop, take to filing as though they had been used to it for years, and have discovered, by observation, that their secret of success consisted in their care and close attention to the work in hand. I have further noticed that the apprentice boy that early becomes a good filer, is, in nine cases out of ten, sure to make a first-class workman. The same qualities that go to make a good filer are the ones required to make a good general workman. It may be taken for granted, then, that the man whose saws are never in order, or who files them in a slovenly ding-dong kind of a way, can never, from the nature of things, become a first-class workman; for care, which is simply a concentration of our energies on one or more particular objects, is the first requisite of a good filer, as it is of a good workman; and if it is borne in mind that "whatever is worth doing is worth doing well," and if one is blessed with an ordinary share of care and perseverance, there will be no difficulty in becoming a good filer, if it is so desired.

The teeth of a saw in action have been likened to a number of men carrying a stick of timber on their shoulders; the tallest men will do nearly all the work. So it is with saw-teeth; the longest points will prevent the shorter ones from doing their share of cutting, and will cause the saw to stick and jerk, to the great annoyance of the user. In putting a saw in order, the first thing to be done is to joint the points of the teeth. For this purpose, the cheaper and more expeditious way is to procure a block of wood, say six inches long, three inches wide, by one thick, dressed straight and true, then nail a similar piece on one edge, thus forming a corner in which to place a file. The file can than be held with the fingers, or be secured in various ways. Place the file flatly on the teeth, and press the larger block against the side of the saw blade, then flle off the points of the longest teeth until the file just touches the extremities of the short teeth. It is important that the file be held in such a position that it will take off the points exactly at right angles with the blade, otherwise the teeth will be longer on one side than the other, which will cause the saw to "deviate" or run more or less.

The saw, being secured in a proper clamp, should be placed where a strong light will fall on the teeth, so that the filer can have the full advantage of all the light he requires. Should there be a deficiency of light, the filer should provide a good lamp, and place a dark shade between the light and his eyes, so that he can see at a glance when every tooth is filed to a complete point. One careless thrust of the file, when a tooth is filed enough, will do a saw more harm than can be repaired by half an hour's filing. A beginner should always take a try-square and the sharp point of a small file, and make a hair-mark from the point of every tooth at a right angle with the teeth on the sides of the blade This should be done when the points of the teeth are all at a uniform distance apart. Such marks will enable the filer to keep the face of every tooth dressed at the most desirable angle. These directions, however, are only applicable to back-saws, panel-saws, and all other saws that are intended for cross-cutting. Beginners must always exercise unusual care when filing the back of each tooth that has been

finished. After the teeth are filed to complete points, it is always an excellent practice to go over them carefully with a file that is half worn out, for the purpose of bringing the points to a more perfect cutting edge.

The cross-cut saw requires finer and more particular filing than rip-saws or web-saws, and I will first endeavor to give an idea how this saw should be filed and set.

A saw is not well filed unless a needle will travel down the angular groove which is formed by the line of alternating points of teeth which is seen in all well-filed saws. Fig. 25 shows the groove The method of using a needle on the edge of a saw, as a test of correct filing, has long been in vogue, and is mentioned by some of the earliest writers on saw filing. When the teeth are so regularly formed that a needle will travel from end to end in the angular groove, and the points are sharp and keen, the saw will cut a kerf in the wood that will have a bottom that is flat, as shown at Fig. 26, and not left raised in the middle as one might suppose would be the case after examining the form of teeth as shown at Fig. 25.

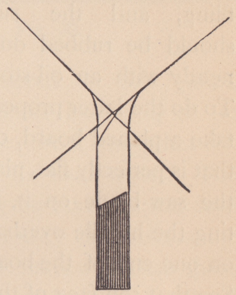

Fig. 25.

The forms of teeth vary in cross-cut saws to meet the resistance offered to them by the materials to be acted upon; thus, a saw intended for cutting hard wood must have teeth stronger than one designed for cutting soft wood. The strength of the tooth is increased by having it wider at the base and giving the cutting angles a less acute form.

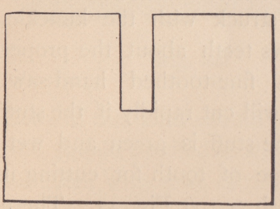

Fig. 26.

At Fig. 27 a diagram of teeth—much enlarged—designed for cutting hard wood, is shown. It will be noticed that the teeth are equilateral, or that the two sides are the same length, and the base line across the tooth the same length as the sides. This is the strongest possible

tooth that can be made consistent with efficiency. Hand-saws for cutting hard wood should never have less than four teeth to the inch; in fact, for general purposes, seven will do better service than four to the inch. Fig. 28 shows a portion of a saw with teeth suitable for cutting dry, hard wood. These teeth are about the right size for a good healthy buck-saw; of course larger teeth in a buck-saw are permissible, but not in a hand saw. It will be seen that the backs of the teeth are left square. The saw should be jointed straight on the edge before filing, and the sides should be rubbed down neatly with an oil-stone. To do the latter properly, take a planed board, one that is perfectly flat, place the saw-blade on it, letting the handle overhang on one end of the board. See that the face of the oil-stone is flat and true, then gently rub it on the side of the teeth from end to end of the saw, until every tooth has been touched. Serve both sides alike. Buck-saw blades should be well strained up in the frame, and should ring sharp and clear when struck with the knuckle. Fig. 29 shows teeth about the proper form for a fine-toothed hand-saw. These teeth will cut rapidly if the stuff is dry; if the stuff is green and wet, the best shape of tooth for cutting it will be that shown at Fig. 27. These saws should have from eight to ten teeth to the inch, and are admirably adapted for cutting mitres and bevel work in medium woods. Fig. 30 shows the proper form of teeth for a tenon or back-saw. Of

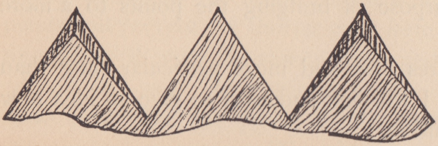

Fig. 27.

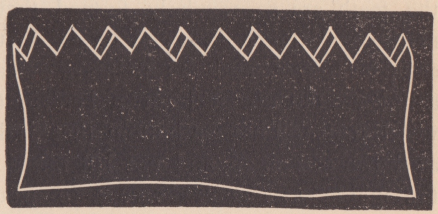

Fig. 28.

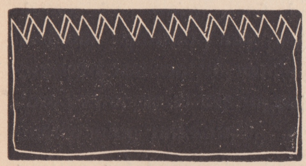

Fig. 29.

course the same form of teeth is required for all back-saws that have to operate in hard wood. For the ordinary tenon-saw, the number of teeth may be anywhere from ten to eighteen to the inch, but for sash and dovetail saws the number of teeth may be from twelve to thirty to the inch, according to the quality of the work required.

The greatest of care should be observed in filing and setting back-saws when intended for cutting hard wood. The great difference between teeth intended for use on hard wood, and those intended for soft wood, is in the angle of the bevel on the point of the tooth. This difference should be studied by the reader as the true principles of saw filing are involved in this point.

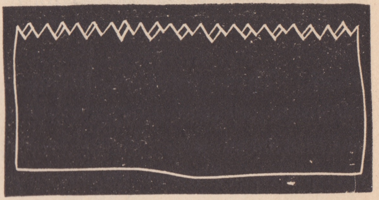

Fig. 30.

Saws intended for cutting wood of medium hardness, or for general use in both hard and soft woods, require a somewhat different treatment than when intended only for hard wood. The greatly-enlarged teeth, shown at Fig. 31, may be taken as standard examples suitable for saws adapted for general use; the teeth at the base are narrower than those intended exclusively for hard wood, like those shown at Fig. 27. At Fig. 32, a portion of a cross-cut saw is shown, with teeth filed about the proper shape for cutting medium woods, or for general purposes.

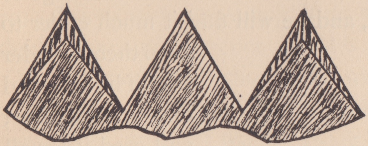

Fig. 31.

Saws of this kind should have about eight or ten teeth to the inch, and should be filed as shown in the figure. Particular pains should be taken with saws of this kind while filing and setting, as the least irregularity in the teeth will greatly lessen the cutting efficiency of the whole saw. The teeth should be jointed down to one length, and their sides should be accurately rubbed down with an oil-stone.

Pruning saws, and saws intended for cutting live green timber,

may be filed in the same form, or nearly so, as the teeth shown at Fig. 32. The exact shape teeth adapted for this purpose is shown at Fig. 33. To cut clean and smooth the teeth require to be filed very sharp, and the bevel should be a little more acute than on a saw intended for dry wood only. Saws intended for pruning and similar work should be ground thin on the back, and kept perfectly bright and straight.

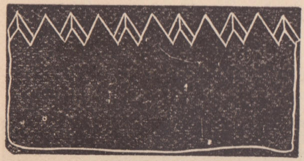

Fig. 32.

Cross-cut saws, required for cutting woods of medium hardness, such as chestnut, walnut, cherry, birch, baywood and hemlock, and which are used for cutting both hard and soft woods as well, are the most numerous, and the teeth just described and shown in Figs. 31 and 32, are of the proper shape for this kind of work. At Fig. 34 the proper angle to hold the file while filing this class of saws is shown. When the workman can afford it, he will find it to his advantage to have saws for each kind of wood, and he will find it much easier to keep them in order than if he only had one cut-off saw, and used it for all kinds of material. I know it frequently happens that a saw must be used on stuff that is full of grit or where nails or tacks have been driven, or, as in cutting openings through plastered partitions, sand

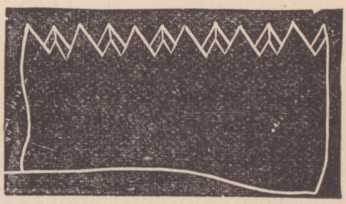

Fig. 33.

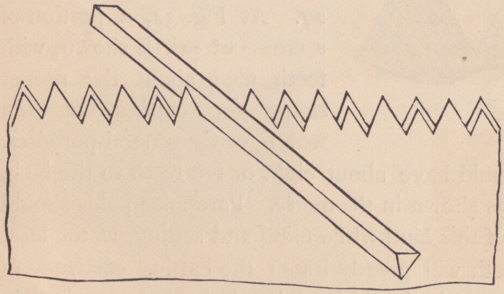

Fig. 34.

and mortar abound. To meet these cases, the workman should carry an old saw in his chest, which he should employ when such work has to be done.

Saw-teeth for cutting soft woods, such as white pine, basswood, poplar, white wood, butternut and similar woods, may have a much sharper pitch than teeth intended for cutting hard or medium woods. An enlarged view of teeth of this kind is shown at Figure 35. These teeth show the extreme limit of both sharpness of bevel and degree of pitch to which it is safe to carry "cross-cut" teeth. They will cut quickly and keenly, but should they come in contact with a "knot," they would not stand, but break off or crumble. Too much "hook" in a tooth is rather a disadvantage than otherwise, unless it is used on the softest kinds of wood, for it will cause the saw to "bite" and stick, to the great annoyance of the workman. True, a saw armed with teeth such as shown at Fig. 35, will cut very rapidly so long as nothing is cut but soft material, but their action is uncertain, and often unsatisfactory. Most workmen file their cut off saws with too much of an undercut or "hook," thinking, no doubt, that such practice enables the saw to cut faster and better. This is a fault, and should be avoided, for a saw filed with too much hook and fleam, like the teeth in Fig 35, will not do much more work, and will require twice the filing that a saw will having teeth like those shown at Fig. 36. This engraving shows the true form and angle of teeth for cutting moderately soft wood, and saws filed correctly as shown, being fairly set and having their sides jointed, and line of teeth true, will give excellent results. About six teeth to the inch is the proper number for hand-saws of this kind, though more or less

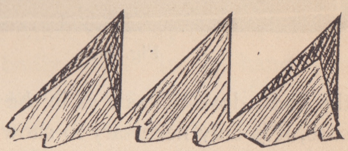

Fig. 35.

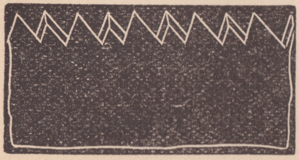

Fig. 36.

teeth may be used with a fair amount of satisfaction. At Fig. 37 is a portion of a buck-saw blade. The teeth are formed for cutting soft wood, and when given a good set and made sharp, straight, and kept well jointed, it will cut green and wet soft wood with a minimum expenditure of labor. As all back-saws should be filed alike when intended for like purposes, that is, when intended for cutting hard wood, the method of filing should be the same in filing the finest dove-tail saw as in the largest tenon-saw. This being the case, it is only necessary to show and describe one example to give an idea of how the whole series should be treated.

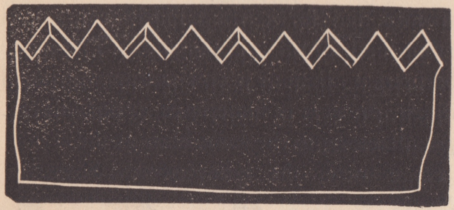

Fig. 37.

The portion of blade shown at Fig. 38 represents a part of a back-saw filed for cutting soft wood. This form of teeth will not make as good work in cutting mitres in soft wood as the teeth shown in Fig. 30, but will cross-cut the softer woods with ease, accuracy and celerity. Let me again caution the young workman about permitting his saws to get "kinked," crooked on the edge, or the teeth to become irregular in size. Good results can never be obtained from a saw indifferently filed and in bad condition. Back-saws require the greatest care, being thin in the blade and finely tempered; they can not stand rough usage or bear to be knocked and "flung around" like the ordinary hand-saw.

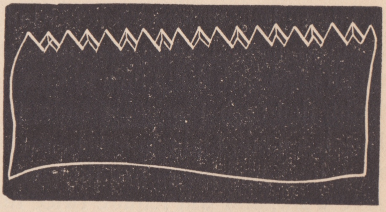

Fig. 38.

I have made the above remarks with a view of inducing workmen—the carpenter in particular—to care for his saws as much as he would for his planes, chisels or other tools.

I have now been through the whole domain of the ordinary cut-off hand-saw, so far as its management is concerned. It must be understood, that by the term "hand-saw," is meant all saws that chiefly belong to the joiner, carpenter and cabinet-maker, and includes rip-saws, hand cut-off saws, panel-saws, and all tenon or back-saws; these are all known to the expert as hand-saws; but these are not all the saws that mechanics are supposed to possess. A "kit" is not complete without it contains a bow-saw or web-saw, a compass-saw, and a pad-saw, or, as it is sometimes called, a key-hole saw. These latter saws all belong to the same class as the scroll-saw, and should be treated as such; the compass-saw, however, deserves a special notice, for in the whole category of saws there is none so little understood or so badly used. In the hand of a rough carpenter it is sometimes painful to see the way this useful tool gets abused. I have seen "wood butchers" purchase these saws at a cost of, probably, forty or fifty cents each, and use them just as they came from the maker; they would cut a stove-pipe hole through a lathed and plastered partition without removing the plaster, and if a lath nail should happen to be in the line to be travelled by the saw, no pains would be taken to draw the nail, and the saw, in consequence, would have to suffer. When this particular job of sawing was done, the saw would likely be pitched into a corner, or flung into the bottom of a chest, there to remain until it was again required for a similar use; but such a thing as filing it, or keeping it in order, was never thought of for a moment. Now, the compass-saw is one of the most useful the joiner employs, and I see no reason why it should be undeserving of as much care as any other saw he possesses. The blade is strong and stiff, and the best are ground thin on the back, so that they cut well with little set, and, when well filed, are much better for cutting out large scroll work and brackets than the bow-saw. Of course, in this age of jig and band-saws, it seems out of place to talk of cutting scroll work and brackets by hand, but the practical joiner will know that even now, in large cities, there is, and always will be, a certain amount of work that must be done by hand, and surely it is better to do what we have to do with good sharp tools, and save

time and temper, especially the latter, than to sweat and tear away with an old and worthless saw.

I have said this much with the hope that my readers will at least treat the compass-saw with as much attention as they would their hammer or their screw-driver. It would be as well, also, at this point, to suggest that it is always bad policy to put away a saw without first filing it, if it has been unfortunate enough to have had a rub on iron, or is dulled from any other cause; for it frequently happens that the next time you may want to use the tool, you will not have any time to spare to sharpen your saw in; therefore, it is always the better plan to file your saw immediately after it becomes dull, or before you lay it aside, and then you are prepared, in this direction, for anything that may arise.

The web-saw, the compass-saw, and the key-hole saw, as before stated, should all be treated alike, and as they are intended to sever wood in every direction in turn—to cross-cut, rip, and cut in every possible direction, and to do this with efficiency—the teeth require to be different than those intended for either cross-cutting or ripping. It is evident, then, that a tooth must be formed that will partake of the nature of both kinds of teeth. This is nearly accomplished in the form of teeth shown at Fig. 39. The size of tooth shown is about right for cutting soft wood; they should be much smaller for hard wood, and somewhat smaller for woods of medium hardness. It will be noticed that the teeth, as shown, have square backs, and are beveled only on the cutting edge; they have also a goodly allowance of "hook" or pitch. These are things that must be observed when filing this class of saws.

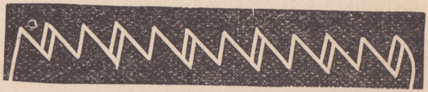

Fig. 39.

Jig-saws and band-saws should always be filed as shown in Fig. 39.

Web or bow-saw blades, compass-saws, pad or key-hole saws, band-saws, and all narrow saws, no matter what the material to be cut, should be ground thin on the back, so as to require but very

little set. The bevel on the cutting edge of the tooth should be short and regular, and the pitch of the tooth should be a little less than a right angle.

So far I have dealt altogether with cross-cutting saws, and saws intended for cutting scroll work, and it is now in order to take up the subject of rip-saws.

It is astonishing to find how few otherwise well-informed mechanics know how to put a saw in good working order, or can file a saw on correct principles. It has been shown, in the foregoing pages, that a cross-cut saw, to be effective, must sever the fibres of the wood at two points, or, in other words, it must make two grooves in the wood and cut them so deep that the centre between the grooves fall out with the reciprocating movement of the saw.

With the rip-saw the case is different; the teeth should make but one groove, which necessitates the teeth being filed square across or at right angles with the blade of the saw; this permits each tooth to strike the wood with its whole width, and acting upon it nearly the same as a small chisel would. Indeed, if we consider the teeth of a rip-saw as a series of small chisels, acting immediately one after another, we may form some conception of the working principle that should govern the formation of the teeth. Each tooth of a rip-saw—no matter whether it be a hand, mill, or circular-saw—should act on the wood to be sawn as a chisel; therefore the nearer the tooth conforms to the shape of a chisel on its cutting point, the faster and easier the saw will cut; but to make a tooth in a hand-saw assume the shape of a chisel while sawing is not a very easy task, though a near approach to it is reached in the teeth shown at Fig. 40. A saw filed like this would be perfection itself, so far as cutting of soft wood was concerned, but the fine point of the tooth, and its delicate structure generally, renders its use inapplicable for

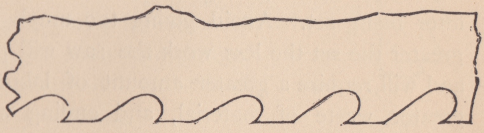

Fig. 40.

general purposes. The difficulty, too, of filing a saw of this kind,

would militate against its general adoption, even if it could be made to do general service. The form of teeth shown at Fig. 41 has been proved to be the best for hand rip-saws, combining, as they do, a near approach to the chisel point, and a strength of tooth at the base that is impossible in any other form of tooth. A saw having teeth this shape, and in good condition as regards sharpness and set, will do good work and a great deal of it when in competent hands, in a short time; and will cut either hard, medium or soft woods with tolerable ease and freedom. The teeth have a considerable hook or pitch, and as before stated, the more hook the nearer the approach to a chisel point and the better adapted for cutting the softer woods. In filing, the file should be held square across the saw in every direction, the back of the tooth should be filed square also, as it is the back of the teeth that leads the saw in a measure through the stuff. Rip-saws, as a rule, require but little set, unless the stuff being cut is green and soft, still a little set is always necessary.

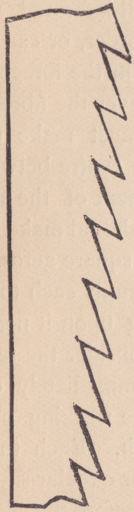

Fig. 41.

When a rip-saw is designed for cutting hard wood only, it might be filed with a little fleam, as shown at Fig. 42, though the backs of the teeth should be left square. This cut also shows the set in an exaggerated form. It will be seen that nearly the whole thickness of the tooth is set overhanging; of course this is too much under any circumstances, but the figure gives an idea of the position of the teeth after being set. Avoid giving too much set to any saw, as the greater the set the less work the saw will perform in a given time, and will require a greater amount of labor to do it, and make a greater waste of material, and ending with very unsatisfactory results.

Here, again, let me caution the workman about keeping his saws straight on their cutting lines and *true* on the sides of the teeth. These precautions are more necessary on rip-saws even

than on cross-cut saws, for if the teeth are unequal and irregular in a rip-saw, it will "jerk" and "catch," and "stick" in the wood

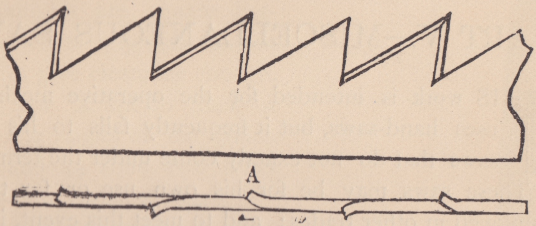

Fig. 42.

until the operator is exhausted with useless attempts to make headway through the board or plank he is sawing.

Fig. 43 exhibits a saw that is much too frequent. There are hundreds of carpenters and joiners that will work with a saw furnished with teeth of this sort, day after day, and feel satisfied that they are doing the best that can be done with a rip-saw. The action of the teeth shown is more like that of a scraper than of a cutter; the teeth simply pound and jam off the sawdust, instead of cutting the stuff to be removed smoothly into chips or shavings. A workman will not do more than half as much work with a saw filed like this, with the same amount of labor, as he will with a saw whose teeth are filed like those shown at Fig. 41. Indeed, a man who uses a saw regularly, with teeth like those shown at Fig. 43, may be likened to a bear possessing "more strength than knowledge." Give these teeth more "undercut" or "hook," and "presto," the change is wonderful.

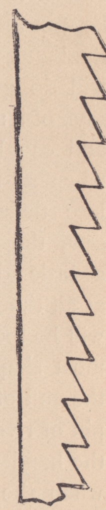

Fig. 43.

PART V.—MISCELLANEOUS SAWS.

THIS work is intended for the operative mechanic who uses hand-saws, but it frequently falls to his lot to file saws that do not exactly come under the term of hand-saws. These saws may be for his own use or for the use of men employed in other trades; and to meet this event, it has been thought proper to give a few remarks and hints on the care and management of other saws than those discussed in foregoing pages.

The two-handed cross-cut is frequently used by carpenters in cutting timbers for floors, roofs, bridges and trusses, and should be kept in the best of order for the purpose. Fig. 44 shows one of the better class of these saws; it is armed with the M tooth, and will do good service when properly filed and set. The maker says of it: "It is greatly preferred in some sections of the country, and can be easily kept in order if filed according to directions, when so many of the fast-cutting saws of the present day must lose their shape and cannot be kept in order. In filing this saw, the round-edge mill-file should be used, and by pressing a little downward as well as sidewise you keep the tooth at all times in the same shape it leaves the factory. Attached to it will be found our new patent cross-cut handle, which is at once the most simple and complete detachable handle now in use. Place the end of the saw-blade into the slot in the casting, then drop the pin or rivet into its position, and a few turns of the wing-nut secures the handle immovably to the saw. Although the pin is quite loose when the handle is detached from the saw, it is by a simple contrivance secured in its place, ready for use, an advantage which will be fully appreciated by all who use the saw."

Fig. 45 shows how this saw is filed. It will be noticed that the bottom of the gullet is semi-circular; this gives a greater clearance for chips and sawdust. Figs. 46 and 47 show two

forms of the M tooth, with the angles of pitch, the set and angle of cutting point. The gullets of these examples are square bottomed, which is objectionable, as they do not give clearance enough, and the saw is apt to crack or break at the angles of the gullet. Figs. 48 and 49 show two other examples of odd-shaped teeth.

Saws with teeth similar to these were made by a firm in Middletown, N. Y., some years ago, but I do not know whether they are manufactured now or not. Holly, in his excellent little work, says, in speaking of this saw: "This saw is constructed on common-sense principles." They may be termed American saws, for, from the evidence before me, I find them to be of purely American origin. They do splendid work, and a great deal of it in a short time, and, taken as a whole, they may be accepted as a success, notwithstanding the expense and care in keeping them in order. The two fleams, *a*, penetrate the wood, and are followed by the hook, *b*, which, after producing small chips or shavings, carries them along and discharges them below the timber. The action bears some resemblance to a carpenter's dado plane, only it cuts in both direc-

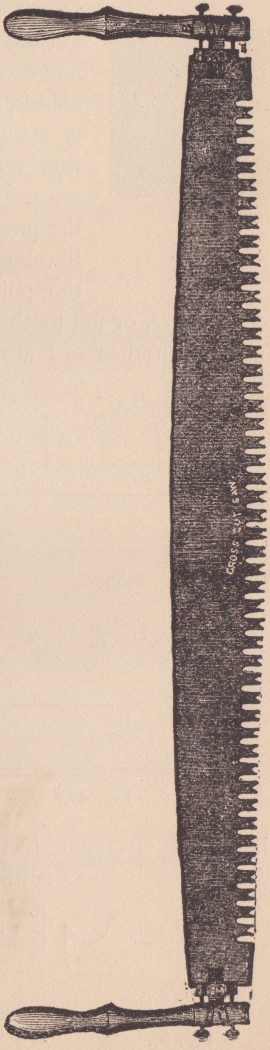

Fig. 44.

tions. These saws will work with freedom and smoothness in the hands of skillful and care-taking workmen, but in the hands of the inexperienced they soon get out of order and become unmanageable, and consequently get a bad name. The cutting chisels, *a*, are filed up square, and the hooks or scraping tools are left somewhat shorter, that too much stuff may not be cut out at once. After all the teeth have been made to the proper length, the cutting teeth are filed beveling, so as to bring them to an edge at the point of the tooth only. This must be done with care, or the tooth will be made too short for service.

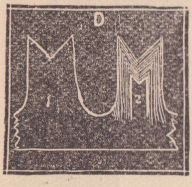

Fig. 45.

Teeth of another sort are shown at Fig. 50. These are called

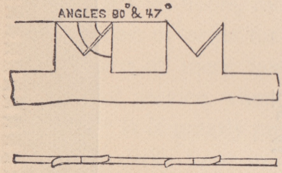

Fig. 46.

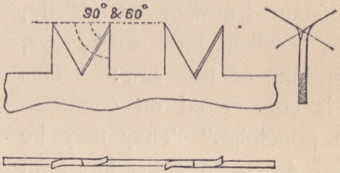

Fig. 47.

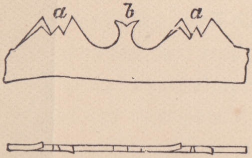

Fig. 48.

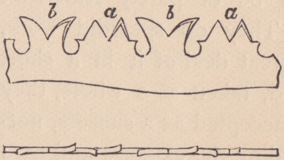

Fig. 49.

the half-moon or crenate teeth. This form of teeth is often used in South America for cross-cutting green timber after it has been felled, and bears some resemblance to the old-fashioned English pruning and grafting saws; they cut very well, but rather slow. The peculiar quality of this saw is its gullet, which gives it an excellent clearance.

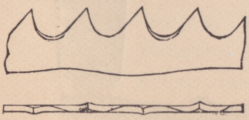

Fig. 50.

Fig. 51 shows a saw with gullet or briar teeth. The term appears to have originated from the fact of the face of one tooth being continued to the back of the following, forming a large hollow or gullet. In gullet teeth, the angles of the faces depend, in a measure, upon the nature of the work they are intended to perform. Fig. 51 is especially applicable to ripping medium

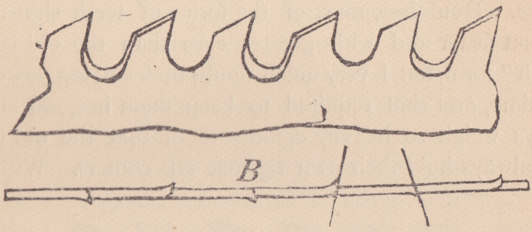

Fig. 51.

woods, whereas, if the teeth approached more to a perpendicular form, it would be better adapted for use in hard woods. Teeth for hard wood should not be very deep, nor have excessive pitch or hook, as it is called, as they will tend to hang or draw themselves into the wood and *stick* fast. The angles for soft wood may be more or less acute, in proportion to the softness.

Fig. 52 shows a very good form of tooth; it will do good service in good hands, but it will never become general, on account of the

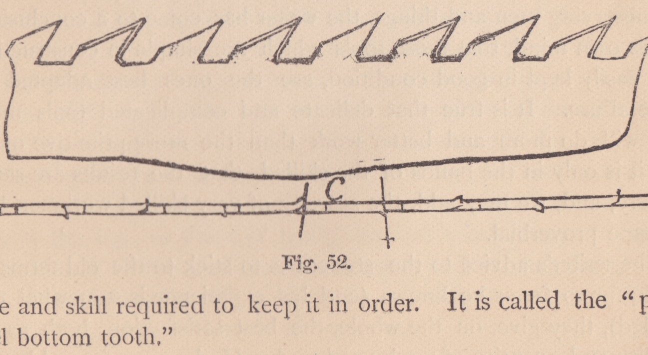

Fig. 52.

time and skill required to keep it in order. It is called the "parallel bottom tooth."

Fig. 53 shows what is termed a "parrot-bill" tooth; it is very imperfect in its structure, and cannot be relied upon to do good work. Its greatest fault is that it will not keep its set; it can only be used in soft wood, and then only with uncertainty as to its action.

Although I have shown a number of odd forms of teeth, and the manner in which they are filed, I do not recommend them for general use. Doubtless, most of the forms of teeth shown in this Part will cut faster and with greater ease than the old fashioned "hog-tooth" form, but I very much doubt their staying powers; and the care, time, and skill required to keep them in good condition will always weigh so heavily against them that the old forms of teeth will always hold their own against all comers. With an ex-

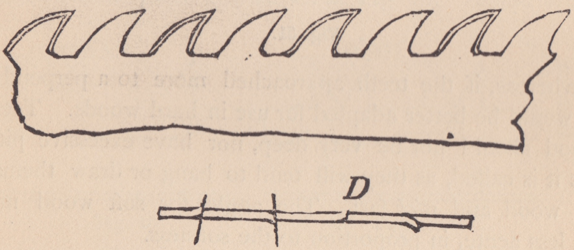

Fig. 53.

perience of over thirty years in these matters, and a peculiar knack for observing men and things, the writer has come to a conclusion, in his own mind, that those tools which are simple in construction and easily kept in good condition, are the ones best adapted for general use. It is true that delicate and complicated tools may, and will, do more and better work than the more primitive ones, but it is only in the hands of the skilled that the results are satisfactory, and, we may add, the scarcity of very skilled workmen has become proverbial.

The writer's advice to the student is to stick to the old forms of teeth, for so far as he knows (and his experience is somewhat extended), they give, on the whole, the best satisfaction, both as to quality and quantity of work produced. Under very favorable cir-

cumstances it is possible to do more and better work with some of the *fancy* forms of teeth; but when the extra time required for filing and setting is considered, and the uncertainty of their action counted, there can be no hesitation in deciding in favor of the old forms of teeth. True, the saw, as yet, is a very imperfect tool, and, in its present shape, must always remain so; but it is possible that it may be made much better than it is; so far, however, there has been little or no improvement in the shape of teeth for hundreds of years. It must be understood, however, that I am not now speaking of the inserted tooth; for if we are to have a perfect saw, it is in that direction we must look for it.

A great variety of forms of teeth have been introduced to the public of late years, and palmed off as being something new and original, when, in fact, they are as old nearly as the saw itself. A copy of a work published in Germany many years ago, is before us. in which nearly every kind of saw-teeth known to the writer is found, and, strange to say, many of the teeth represented in the work are the same as some of those patented in this country within the last twenty-five years. Though invented and used many years ago, these odd-shaped teeth have fallen into disuse in the countries where they originated, thus proving that they were not adapted for general purposes.

The cutting qualities of a saw depend very much on the manner in which it is set, for it is self-evident that the projection of any one tooth beyond its proper limit will cause the surface of the material acted upon to be rough and deteriorated in proportion. Moreover, the saw will be apt to run or deviate from a straight course; it draws into the stuff, and will be sure to cut most rapidly on the side most set. The true criterion of sharpening and setting is the perfection of the angular groove, formed by the two rows of teeth points on the cutting edge of the saw, as before shown; and no matter what may be the style or shape of teeth, this fact must always be borne in mind that all the teeth must be regular, and the angular groove perfect, or the results will certainly be unsatisfactory.

At Fig. 54 is an old style of peg-tooth. This is designed for a double cross-cut saw; it cuts both ways, and will do pretty good

service, and furthermore, is easily filed and set. For hard wood, the teeth might be a little shorter, thus making the points assume

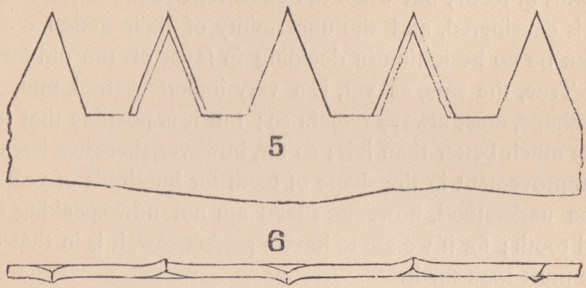

Fig. 54.

a less acute angle. The set of the saw is also shown. Fig. 55 is also intended for a double cross-cut; it is an improvement on Fig. 54, inasmuch as it is adapted for both medium and hard woods. Both these examples require flat files to sharpen them, but almost any person who knows the use of a file can sharpen these kinds of saws if they but try intelligently.

Fig. 56 shows teeth suitable for a cross-cut saw, adapted for

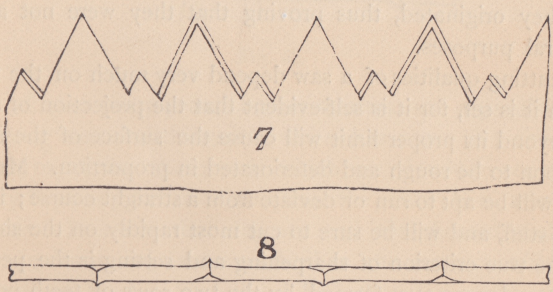

Fig. 55.

cutting either soft or hard wood. A saw with teeth like these will not cut very rapidly, but it will be certain in its action, and will stand a great deal of wear and tear. The second diagram shows the set suitable for the saws represented.

A knowledge of the principles involved in filing the following saws may prove useful to the wood-working mechanic, as sometime or another he may be called upon to file and put in order similar ones.

Fig. 57 shows the teeth for a hack-saw, a tool designed for cutting brass or iron. The teeth should be fine and filed square

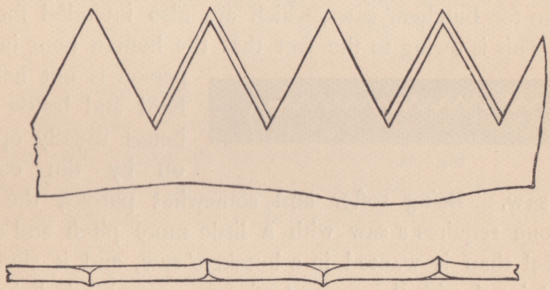

Fig. 56.

across; and the backs of the teeth should be filed square also. The teeth must be jointed all to one length and filed up to sharp points, and must stand square out on the edge of the blade. It is better not to joint saws of this sort on the sides, as the edges left on by the file help the saw to cut the metal. I have seen a piece of an old scythe do good service as a hack-saw when the latter was not at hand. The edge of the scythe was nicked with a cold chisel, or the teeth formed with an old file, and the results obtained from using the impromptu saw were quite satisfactory.

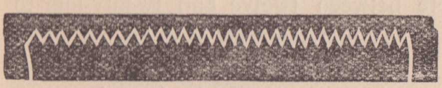

Fig. 57.

A hack-saw is simply a very thin file with the cutting teeth all on one edge.

The butchers'-saw has some resemblance to a hack-saw, and the filing and general treatment are nearly about the same. There is one very important difference however, as may be seen by comparing Fig. 58 with Fig. 57, and that is the difference of width of teeth

at their bases. In Fig. 58 the the teeth are much wider; indeed, they are intended to be equilateral; this gives the pitch of the teeth an angle of sixty degrees, front and back. To work well these saws must be well jointed and filed square front and back.

Although the saws used by surgeons are chiefly intended for cutting bone, the manner of filing and treating them is something different than for butchers' saws, which are also intended for bone cutting. This is owing to the fact that the human bone in a live person is not nearly so hard and brittle as the bones usually operated on by the common butchers'-saw. Being softer and somewhat porous, the living human bone requires a saw with a little more pitch and a more acute bevel than is wanted in a butchers'-saw, and it should be filed and jointed with the greatest of care, every tooth being on a line, and the sides should be jointed so that every tooth will be in line at every point on its cutting edge. Fig. 59 shows the shape of teeth; it will be noticed that they resemble teeth filed for cutting hard wood, as shown at Fig. 30. The number of teeth required in these saws may be anywhere between twelve and twenty-four to the inch, but there appears to be a preference for saws having about sixteen, though, of course, there are saws that will require teeth much finer than this, but they will rarely, if ever, be brought to the notice of those for whom this work is intended.

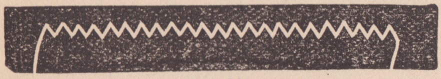

Fig. 58.

Fig. 59.

Saws intended for cutting combs are made so different to other saws that it is scarcely necessary to introduce them here at all; however, a brief description may not be out of order.

The blades or plates of these saws are made of thick steel, and are ground away on one side and edge until the blades are the thickness of the notches in the comb. These saws are generally set in the wooden stock which forms the handle. Two grooves are made in the block, and the blades are inserted and then wedged

in solid with wooden wedges. One blade is left a little wider than the other, so as not to strike the edge of the comb at the same time. The division between the plates regulates the distance between the teeth of the comb. The form of the teeth is something like that used in the hack-saw, but may have a slight bevel on the cutting edge.

For cutting ivory, teeth like those shown in Fig. 57 are mostly employed; sometimes, however, the teeth may be formed like those in Fig. 58, and a slight bevel given to the cutting edge. Saws for this purpose are nearly all web-saws and held rigid in a frame of either wood or iron. Circular saws, of course, are an exception to the general rule. Most of the ivory used for piano keys and like purposes, is cut into thin strips by small stiff circular saws. The inlays made with ivory, ebony, brass, silver and gold are cut with fine narrow saws having teeth formed like those in Fig. 57. Work of this kind is mostly done now by aid of the modern scroll-saw, most of which are supplied with saws that have teeth adapted for the purpose.

The mode of using saws for metal is the reverse of that for wood; as for metal, the motion should be slow and the pressure somewhat considerable, and the necessity for each of these conditions increases with the increasing hardness of the material. The saw should in all cases be lubricated with a little grease of some kind, and the back strokes should be made without pressure on the blade, but the saw should not be raised from the bottom of the groove. The blade should, in all cases, be kept well strained in the frame; this will enable the operator to work with greater ease and exactitude.

It was not originally intended that anything regarding machine-saws should be discussed in this work, but I feel the necessity of having something to say on the subject, for nearly every wood-worker nowadays, in the course of his daily occupation, finds it necessary to know something of the jig-saw, band-saw, or small circular-saw. The same laws that govern the cutting qualities of a reciprocal or rectilinear saw hold good in the other saws.

Jig-saws are rapidly falling into disuse; the band-saw and duplicating machines do the same work with greater ease and speed.

Whatever I have to say of jig-sawing can be said in a few words.

In setting up a jig-saw choose the most solid part in the building, over a post, pier or timber; if on a ground floor it should be set on solid masonry or piles. If you are obliged to put the saw on an upper floor, use a counter-balance equal to three-fourths the weight of the movable parts; this device will throw the vibration on a horizontal plane. When a jig-saw is set on solid masonry no counter-balance is required, as it is better to let the vibration fall vertically on the masonry. It is not wise to drive jig-saws at too high a speed, as the wear and tear of the machinery will more than balance the gain in speed of sawing.

Nearly every person who has seen a practical hand at work with a jig-saw feels convinced that it must be a simple matter to run one; this, however, is a great mistake, for men who may be the best of workmen in some branches may make the poorest jig-sawyers, and it has long been known among the "knowing ones" that to make a good sawyer requires a special faculty, and the gifted ones are not over numerous. The man who has this "gift" scarcely knows how he follows the lines; he appears to do so by intuition and without effort, and depends on this natural gift instead of acquired skill. Sometimes men who have the greatest difficulty in learning other branches become experts in scroll-sawing almost immediately, and when this "faculty" or "gift" is discovered it should be encouraged, and it can be done with profit to the employer and employed.

Saws for scroll-cutting should possess an intermediate form of teeth, neither pointed, as for cross-cutting, nor square, as for ripping, but of a shape partaking of both, as they will have to cut at all angles of the grain, and should be in a hook form.

Saw-blades that are narrow are incapable of withstanding much back thrust, and should always be filed so as to lead into the wood. The saws should be beveled back from the teeth, and should be evenly ground.

It is reasonable to suppose that changes will soon take place in the style of wood ornamentation, or that other devices will be in-

vented that will in time do away with the necessity of employing jig-saws. Their use is now almost restricted to perforated work in the best shops, and even their use in this branch of work, let us hope, may soon be superseded by rotary or other equally effective tools.

Fig. 60 shows a very good example of Jig-Saw. The saw is held taut by spiral springs placed in the hollow cylinders shown at the top of the engraving.

There are a great many different makers of these saws, each one claiming some particular improvement. Doubtless, many of them possess distinctive features that are improvements over the corresponding parts in others, but on the whole the difference between them, when costing about the same, is very little.

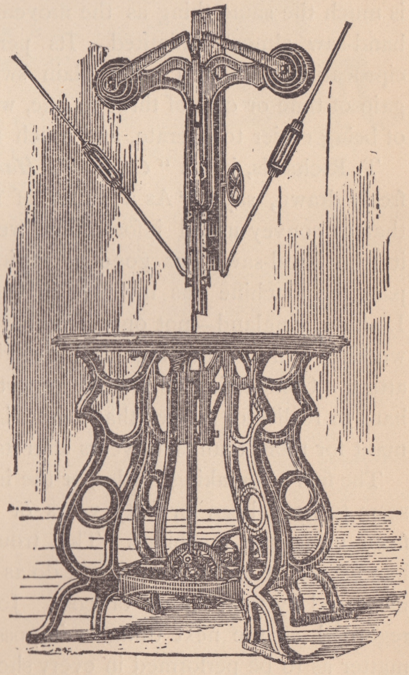

Fig. 60.

Perhaps, since the introduction of wood-working machinery, no tool has so rapidly gained the favor of builders and those interested in the various manipulations of wood, as the band-saw. This is not to be wondered at when it is considered that the advantages over the old style reciprocating saw are so many and so obvious. The future of this class of saw is hard to predicate. Judged upon general principles, and by the laws that govern

sawing, one is at once led to conclude that it must supplant every other method, and nothing but insurmountable mechanical difficulties can prevent its becoming the standard saw for every kind of use. Analyzing the principles of its action, it may be said to have a blade of superior thinness, capable of tension in varying degrees, moving in right lines through the material at a speed that is almost unlimited, and can exceed that of circular saws, operating, too, by machinery, consisting only of rotating parts, and of the most simple construction, the sawdust all carried down through the timber, offering no obstruction in following lines. Add to this the peculiar adaptation of the band-saw to curved lines, and its advantages cannot be over estimated. The speed of sawing, or the cost of sawing, which is much the same thing as the movement of the teeth, is with the band-saw almost unlimited. Its performance, contrasted with reciprocating saws for cutting plain sweeps or scroll-work, shows a gain of time or cost of three to one, with the important advantage of being easier to operate, and much more popular with workmen.

T. Richards, in his "*Operator's Hand-Book*," from which I have freely drawn, says, "As a matter of interest to the reader rather than to convey useful information, we will mention that although it (the band-saw) has gone so rapidly into use in the nine years past, the machine was invented in 1808, by William Newberry, of London, England—not only invented, but built in a good, practical working form, as drawings and descriptions yet in existence fully attest. Considering its present importance and extended use, it is hard to realize or believe that a machine of the kind should lie dormant for more than sixty years after its invention."

The fear of breaking blades, or the inability to manufacture them, seem to have been for forty years or more what deterred people from using the machines. This trouble has been overcome, and band-saws, of good quality, will do as much cutting as other saws, measured by their value or cost. Joining the blades, from being regarded as the next thing to impossible, has become so simple a matter as to be performed in every shop, and almost by any person.

At Fig. 61 is shown a *Band-saw*, arranged to cut bevel work. These saws are manufactured in New York. They can be

made to cut vertical or inclined. They are excellent for some purposes.

Small circular-saws for wood-working factories, whose diameters range from six to eighteen inches, are known to every wood-worker in the country, and therefore need no description here, though a few words as to their management may not be out of place.

The first and most important requirement in a saw is, that the blade shall be perfectly straight and true. That is the foundation of all good work with any kind of a saw, whether it be a small one that will hardly go through an inch board or the largest saw made. If the plate is crooked or sprung in the least, there is trouble sooner or later, and no setting or filing can ever remedy the defect of a warped saw-plate. Taking it for granted that the plate *is* perfectly true, the next thing is to have it as near round as possible, for a saw that is not round will buckle if it is driven hard, because one side does cut and the other side takes the whole strain, and, unless it is thicker than it ought to be, will buckle from the unequal strain that is put on it. This acts the same on both large and small saws, but especially so on large thin saws. A large saw, running in a table without guide pins, is apt to get out of round, and sometimes will run both ways, or one piece will bind in the gauge and the very next one, perhaps, will draw away from it. A great many are puzzled to see a saw bind in one cut and run free in another, but if they would joint their saw round, and square across, everything else being right, a saw will run easy every time alike, unless it gets a little too warm in the centre. Great care should be taken to joint a saw perfectly square across, so that it will draw both sides alike, for if one side is longer than the other it will draw off on the longest side. No matter how perfect everything else may be, no filing will make a saw run well if it is not jointed square across, and no saw will run well if it is not filed well.

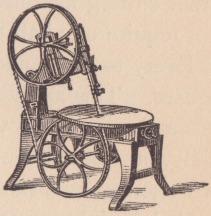

Fig. 61.

A diamond will not cut when dull. Why should a saw? A few minutes filing two or three times a day will save ten-fold the amount

of time and labor expended in running an imperfect, dull saw, also making a saving in the power consumed, which, in some mills, is a very important consideration, and a heavy percentage in the quantity as well as the quality of stuff cut in a day, month, or year.

It is a mistaken idea that there is a saving by not taking time to sharpen the saw. If a saw was a razor, and the man that works it was obliged to shave with it, then the saw would be kept sharp. It is quite as essential that a saw be sharp as a razor, or plane, or any other cutting instrument, and when proud, or full and sharp, it does not require one-half the set or power on the same feed.

Every tooth should be filed the same, whether filed fleaming or square. This applies to saws of all sizes and all kinds. Each user of small saws has a very decided opinion of his own regarding saw-filing, but there is only one opinion about having every tooth alike. No one can ever make a good smooth cut with a saw if one tooth is filed straight up and the next very hooking, and the next one to that is half-way between the two others, no two teeth being filed alike. The custom in a great many places is to keep the saw sharp, and many think that if a saw is only sharp, no matter what the shape of the tooth may be, it is bound to cut. I am not fully convinced in my own mind which is the *very best* way of filing small saws for light *clean* work. I have seen saws from ten to eighteen inches in diameter filed very fleaming, and cutting almost as smooth as can be planed; and I have also seen saws from eighteen to sixty inches, filed as square as possible, do just as good work. One thing I am sure of, however, and that is, a rip-saw will cut very much easier filed perfectly square. If any one doubts this, let him take saws filed both ways, and use them in a machine run by hand-power.

If one is sawing constantly on clean dry work, he can file his saw different than he can on job-work, where, perhaps, one piece is hard oak, and the next spruce, and so on, constantly changing from one kind of wood to another. In this case he must strike a medium line, and be governed by conditions. The better way in such a case is to file the fronts of the teeth perfectly square

and just give the tops bevel enough to make the outside points of the teeth a little the longest.

In filing a saw begin at the bottom of the tooth and work up to the point, so that the pitch of the tooth shall always be kept the same. There is no use to sharpen the point of the tooth and work down to the base, for if you do the teeth will be out of shape in no time, and then the saw will not run straight. The great trouble with many using bench-saws is, if they bind in the gauge, to drive the piece through, if possible. Nothing can be more foolish, for the very best saw made may be spoiled in one cut, for it will be bent over on the collar, and will likely be buckled or warped.

The saw gets hot just above the collar, and becomes a trifle softer in consequence, and it stretches from this point out to the rim, dishing it more or less. There are but very few men running bench saws that know much about them. If a saw goes well, all right, but if there is any trouble they call it hard names, instead of fixing it. Hard names will not make a saw work smoothly. More saws are spoiled from carelessness than from hard work

Theory may do something for saws and sawing, but to come down to a fine thing a person must come into daily practice with them, taking them as he finds them, and using his best judgment in every case, and very often then he will find himself at his wits' end to overcome all the difficulties he meets with. What may be good for one saw may not serve another.

If a person using saws, should in the first place see that he had a good straight plate, and, in the next, see that it was round on the points of teeth, and square across, and then file every tooth alike and just the same bevel and shape, and keep an even set in it, unless he abused it, he would not find much trouble in sawing.

A recent writer* on the subject of saws, says: "The grand secret of putting any saw in the best possible cutting order, consists in filing the teeth at a given angle to cut rapidly, and of a uniform length, so that the points will all touch a straight-edged rule without showing a variation of a hundredth part of an inch. Besides this, there should be just enough set in the teeth to cut a kerf as narrow

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*In Leffel's "Mechanical News."

as it can be made, and at the same time allow the blade to work freely without pinching. On the contrary, the kerf must not be so wide as to permit the blade to rattle when in motion. The very points of the teeth do the cutting. If one tooth is a twentieth of an inch longer than two or three on each side of it, the long tooth will be required to do so much more cutting than it should, that the sawing can not be done well. Hence the saw goes jumping along, working hard and cutting slowly. If one tooth is longer than those on either side of it, the short ones do not cut, although the points may be sharp. When putting a cross-cut saw in order, it will pay well to dress the points with an old file, and afterward sharpen them with a fine whetstone. Much mechanical skill is requisite to put a saw in prime order. One careless thrust with a file will shorten a tooth so that it will be utterly useless, so far as cutting is concerned. The teeth should be set with much care, and the filing should be done with great accuracy. If the teeth are uneven at the points a large flat file should be secured to a block of wood in such a manner that the very points only may be jointed, so that the cutting edge may be a complete line or circle. Every tooth should cut a little as the saw is worked. The teeth of a hand-saw, for all sorts of work, should be filed fleaming, or at an angle on the front edge, while the back edges may be filed fleaming, or square across the blade. The best way to file a circular-saw for cutting wood across the grain, is to dress every fifth tooth square across and about one-twentieth of an inch shorter than the others, which should be filed fleaming at an angle of about forty degrees."

Heating spoils saws. Some sawyers will run a saw until it is tremendously hot, and, to make it worse, they throw cold water on the side, thus causing sudden contraction on that part of the saw, and after a few such times, the saw has to go to the factory to be hammered and put in order, and to come back to meet the same fate as before. If the saw is round, hangs true in mandrel, is in line with the carriage, filed square at top and bottom, the backs of the teeth lower than the points, with the required amount of spread set, and the teeth kept well chamfered with a gummer, so

that when the saw runs, only the point will come in contact with the lumber, then a saw will run free and cool, and there will be no extra strain on the plate, no heating nor danger.

Before commencing to sharpen a saw, care must be taken that it is held firmly, or accurate sharpening will be very difficult, and at the same time the saw file will be soon stripped and worn out should there be much vibration. For sharpening saws, the files employed are triangular, flat, round, and half-round, to suit the various angles and shapes of teeth. A saw-vice arranged to angle for gulleting or throating should be used; the angling can be secured for mill-saws by mounting the vice on quadrant joints, or for circular saws the vice may be of any of the known forms. The saw will be held much steadier if thin sheets of lead are placed between the jaws. Teeth set towards the operator should never be filed at the same time as those set from him, but the saw should be reversed. Mr. Grimshaw, in his valuable book on saws, says "the saw file should be held for hard woods 90° to 80° horizontally; for soft woods 70° to 60°, and less, the vertical angle being half the horizontal and less important. First, top the teeth by passing the file lengthwise over them to equalize their length, bearing harder on the ends, where there is least wear. File the faces or fronts before the tops. When the teeth are to be square file in regular succession 1, 2, 3, 4; when the file is inclined, so as to give "fleam," file 1, 3, 5, 9 to right, 2, 4, 6, 8 to left." Or, in other words, every other tooth should be filed in order, then the saw reversed, and the unfiled teeth taken in their order.

No exact rule can be laid down as regards filing the bevel on the back edge of the tooth, but speaking generally, the softer the wood the more bevel should be put on the tooth, and the harder it is the less bevel. The following points should be borne in mind: In straight cross-cut saws the cutting is all done by the outside edge of the tooth, and the more bevel there is put on the point of the tooth the deeper it will cut; care must, however, be taken that it is not made to cut too deep, as, unless there is ample clearance for the sawdust, the saw will be found to jam and buckle. In cutting different kinds of wood, it is the bevel of the point of the tooth which

should be varied and which governs the cut of the saw. In cross-cut saws the cutting edge of the teeth should not have too much pitch, else they will be found to drag in the cut. After filing a saw, any feather on the cutting edges of the teeth should be removed by rubbing a whetstone or smooth file over them; this spreads the cut of the tooth, and does not confine it to its extreme point. In practice it will be found advantageous to have a tolerable variety of saws for different classes of work, and not to make two or three do duty for everything.

Circular-saws sometimes burst from what may appear as unknown causes. There can be no doubt, however, when a saw does fly in pieces from some apparently unknown cause, but that a thorough investigation would trace the occurrence to one of the following causes:

"1. Square corners at bottom of tooth.

"2. Out of round, with the backs higher than the points, so that instead of cutting, they scrape the dust off with the back.

"3. Undue strain put upon the saw by the plate rubbing against the timber, causing it to heat, which takes the life out of a circular-saw."

PART VI.—REMARKS ON SAWS, SETS AND FILES.

SAW-FILES.—Remember that there is no difference whatever in the angles of three-sided equilateral saw-files, the bevels of the sides are always the same; there can be, and is a difference in the cut of files, some being very fine, and some being very coarse; those that are the finest cut are the most serviceable for saw-filing. The length and size of the file to be used are matters that must be left to the judgment of the user.

IN making a selection of a file, bear it well in mind that there are several qualities made; some file-makers have as many as four qualities—first, second, third and fourth. The first quality is, of course, the best, and represents about 75 per cent. of a file-manufacturer's product, the other qualities taking up the remaining 25 per cent. Firm names are always stamped on files before they are tempered, and if, after they are finished, any of them are found to be poorly cut or badly tempered, the firm name is ground off, and one of several fancy names stamped on each file belonging to a certain quality. Thus if a file-maker should select the word "Jumbo" for his second-quality files, all of his files which are too poor for the first quality and too good for the third have "Jumbo" stamped on them. First-quality files only bear the name of the maker, while fourth-quality ones generally bear no name at all, and are seldom seen and more seldom sold. When you have thought of all these things, ask the dealer for a first-quality file, bearing the name of some well and favorably known file-maker—one that you have heard of yourself, if you ever heard of one. Select the heaviest file you can get (if there is any difference in the weight of them), for a heavy file is generally truer than a light one of nominally the same size, and is better for recutting, a recut file, by the way, being just

as good as a new one. Take the file to the light and hold it in a horizontal position, the point of it toward you. The teeth of the file will now be pointing toward you, enabling you to detect easily any and all imperfections that a bad file is heir to. If the conformation of the teeth is irregular or uneven, or if the color of the file is not uniform, let it severely alone. A spotted or mottled file denotes unevenness of temper. If, on the other hand, the file presents a clean, white color, it denotes that the temper of it is hard and even throughout; and if, besides this, it has regular and perfect teeth and bears the maker's name, you may rest assured that it is an excellent file. The best files are tempered at a low heat. Files of certain sizes and numbers made since the 1st of June, 1882, are of uniform weight, the file-manufacturers of the United States having agreed upon a standard of weights and sizes.

A POOR file is a most worthless article; yet it is astonishing how many such are manufactured; and why?—simply because inferior stock is used. Many *saws* are made from worthless steel, but *some* files are made from even worse material. They have been known to be made of iron and case-hardened. It is impossible for such a file to be of any service, even on a poor saw. Then what chance would it stand on one of the best saws?

BEFORE using the file see that you have a decent handle for it. It is a waste of time, labor and money to attempt to file a saw with a file having no handle or a handle that is ill-shapen and that will not stick on the tang of the file. The filer should supply himself with a number of good handles, and see to it that they are the proper size and shape.

CIRCULAR SAWS THAT ARE NOT CIRCULAR.—When a saw is not round the defect may be corrected by adopting the following directions: Take a piece of grindstone or a cobblestone and hold it against the points of the teeth while the saw is revolving, and thus reduce or wear down the most prominent teeth; or a piece of red chalk may be held against the points, which will mark them in proportion as they are long or short. The long teeth should then be reduced by filing.

To Become an Expert Sawyer.—1. Thoroughly study your saws, their motors and attachments.

2. See that both the machinery and saws are in good order. A man cannot do the best work when he is in ill-health, neither can machinery do the best work when it is in ill-repair.

3. Bear in mind it does not follow because one saw will work well that another will do the same on the same mandrel, or that even two saws will hang alike on the same mandrel. On the principle that no two clocks can be made that will tick alike, no two saws can be made that will run alike.

4. It is not well to file all the teeth of circular-saws from the same side of the saw, especially if each alternate tooth is bent for the set, but file one-half the teeth from one side the saw, and of the teeth that are bent from you, so as to leave them on a slight bevel and the outer corner a little the longest.

5. Never file a saw too sharp or too acute under the teeth, but on circular lines, as all saws are liable to crack from sharp corners.

6. See that each tooth will do its proportional part of the work, or if a reciprocating saw, keep the cutting points pointed on a straight-edge.

7. Keep the teeth of your saws so that they will be widest at the very points of the teeth, otherwise the saws will not work satisfactorily, the tendency of all saws being to wear narrowest at the extreme points.

8. The teeth of all saws should be kept as near a uniform shape and distance apart as possible, in order to keep a circular saw in balance and in condition for cutting.

9. And lastly, never crowd your saw, feed regularly and with such speed that the saw will always work free and clear.

Speed of Circular Saws.—The speed of a saw is reckoned on the distance that the line of teeth travels in a given time. Circular-saws run, under ordinary circumstances, from 8,000 to 10,000 feet per minute, or nearly 200 times faster than a hand-saw, which makes about 100 feet in the same time, only being at work on the downward stroke for a distance of 50 feet. The following table shows the speed of four sizes of circular-saws. It will be noticed

that the smaller the saw the greater number of revolutions per minute will be required to make up the necessary speed:

Size.	*Rev. per min.*
8 inch	4,500
12 "	3,000
16 "	2,222
20 "	1,800

The speed of circular-saws for cross-cutting can be increased with advantage 1,000 feet beyond those used for ripping, say to 10,000 feet per minute. The difference in the cutting action of the two kinds of saw-teeth will readily account for the necessity of this increase in speed. In the case of a ripping-saw, the action is chiefly a splitting one, the saw-teeth acting like a series of small wedges, driven into and separating the longitudinal fibres of the wood, while with the cross-cutting saws the fibre of the wood which has to be severed across the grain, is comparatively unyielding, and the teeth of the saw meeting with more resistance, makes it necessary to have the teeth much more upright and more acute or lancet-shaped in their form than for cutting with the grain.

One rule the operator should always follow, and that is never to cut with a circular-saw stuff that measures more than one-third its diameter. The manner in which a circular-saw is hammered has much to do with the speed at which it can be run, and often when a saw becomes limber and "runs," it is the fault of the hammering instead of the speed. When slack on the periphery it will not stand speed, and becomes weaker and bends more readily when in motion than when it is still; on the contrary, if it is properly hammered, a little tight, as it is termed, on the periphery, it becomes more rigid when in motion up to a certain limit. The theory of this is that the steel is elastic, and is stretched by the centrifugal strain in proportion to the speed, which is greatest on the line of teeth, and diminishes to the centre.

If saws evince a tendency to spring and a want of rigidity, have them rehammered at once before changing the speed in an endeavor to remedy the defect.

Cutting wood is somewhat similar to cutting iron; hard wood cannot be cut at so high a speed as soft wood. Anyone who has had experience in working oak, maple, mahogany, rosewood, lignum vitæ, or other hard woods, will have noticed that a high speed soon destroys the cutting points by overheating.

In sawing very hard wood the speed of both the saw and the feed of the wood should be reduced, the former about one-quarter and the latter one-half or even less. Most circular-saws may have the feed varied from 5 ft. to 60 ft. per minute, according to the nature of the wood to be operated on. It may be taken as a rule the higher the speed at which a saw runs, the fewer teeth are required, the cutting action of the saw becoming more and more continuous, and I am inclined to think that some of the circular-saws made in this country, for sawing soft wood especially, contain too many teeth; thus more power is consumed without a corresponding increase in the cutting action of the saw—in fact, in some cases it is considerably less, as owing to the number of teeth the throat or dust space is insufficient to allow of the instant escape of the sawdust. One important thing in the manufacture of circular-saws, and, in fact, all kinds of saws, is that for hard wood much less set in the teeth will answer. A saw that has the set made a trifle more than the thickness of the plate, will do more and better work on hard wood than a saw having a set nearly twice the thickness of the blade.

Speed of Reciprocating or Jig-Saws.—The cutting and feed speed of these must necessarily vary according to the size and nature of the wood being sawn and the construction of the machine in use. The usual speed these saws are made to run is about 300 strokes per minute, more or less, according to the length of stroke, making the average stroke about eight inches. I have seen jig-saws, however, run considerably faster than this.

Where high speeds are attempted the bearings should be of increased length, the various working details very accurately finished, and all revolving parts carefully balanced; the moving parts should combine strength with lightness, as far as possible, and un-

less all these points are borne in mind, high speeds will, without doubt, end in disappointment to the users of these saws.

The speeds of the various machines should be kept as equable as possible; ample motive power should therefore always be employed. In arranging the pulleys for running any kind of wood-working machinery, to obtain the correct amount of speed an allowance of about $7\frac{1}{2}$ per cent. should be made for slip: this, however, should be increased if the belts are run in a vertical line or at short centres.

The speed of the feed may be varied according to the nature of the wood being sawn. For very hard wood a feed of 6 in. per minute is suitable, whilst for very soft wood as much as 30 in. may be cut in the same time; it is a great mistake, however, to force the feed, as the sawdust has not time to escape, and the saws become choked and buckled, and run out of line. I take it that in all kinds of sawing it will be found better and more profitable to do a fair amount of sawing thoroughly well than to do an increased amount badly.

These saws should be ground thin on the back, should have a medium set, and be filed for cutting the various woods, as shown in Fig. 39.

Band-Saws.—The working action of a band-saw, is, generally speaking, similar to the working action of a circular-saw, continuous. Owing chiefly to the thinness of the gauge, the small area of the blade which operates on the wood at one time, and the constant cooling action which is going on, as the saw passes through the air, a comparatively small amount of heat is engendered; the saw therefore can be run at a considerable speed without detriment. On machines in which the saw-wheels are of small diameter, say below 36 in., and where the arc of contact of the saw on the wheels is necessarily more acute, the speed of the saw-blade should not much exceed 4,500 feet per minute for all ordinary kinds of sawing. With saw-wheels above 36 in. diameter this speed may safely be increased up to 6,000 feet per minute; this is, however, on the supposition that the top wheel is of the lightest

construction, and mounted elastically, *i.e.*, has a spring or other adjustment to allow for the expansion or contraction of the saw-blade, but no good machines are now made without this.

There is no advantage in running band-saws beyond 6,000 ft. per minute, as the breakages are increased without any corresponding gain. As most of the work of a band-saw is fed by hand, and is sometimes intricate, it cannot in any case be advanced through the saw at a greatly increased speed.

In sawing hard woods, the speed of the blade should be, but rarely is, reduced; for sawing very hard wood or ivory one-sixth the ordinary speed will be sufficient; for sawing iron the speed should be about 250 ft. per minute.

As I have before stated, the band-saw was invented and patented prior to the year 1808, by one Newberry, of England, but it fell into disuse owing to the fact that no saws suitable for the purpose could be obtained, and it was not until the introduction of crinoline by the Empress Eugenie, that blades could be made.

The cane used at first for making hoop-skirts soon proved to be too heavy and clumsy, and steel wire was substituted. This also was found to be too clumsy, as it had too much horizontal section. Finally all these difficulties were overcome by the invention of means whereby steel could be made as thin as ribbon and of almost any reasonable length. This invention was further improved on by M. Perin, of Paris, France, who eventually turned his attention to the manufacture of band, or ribbon-saws, as they were once called, and perfected them so as to render their use profitable. Thus we see that a woman's fancy was the cause of bringing into use an instrument that bids fair to crowd out of all our wood-working factories the clumsy, dangerous, and unscientific circular-saw.

For many years, Messrs. Perin, Panhard & Co., of Paris, France, have had almost the exclusive trade in this class of saws, but lately I have seen band-saws made in this country that were equally as good, in many respects, as the imported blades—and much cheaper.

The same rules that govern the form and set for jig-saw teeth hold good with band-saws.

The greatest objection to a band-saw is that it cannot be used for cutting inside work. Some workmen saw clean through the stuff to get at the inside, when the nature of the work will admit of such treatment without weakening or injuring the design. Strips of the same kind of wood as the design are firmly glued into the saw-kerfs when the work is completed. Of course, this method of reaching inside cutting can only be adopted where the design is not intended to bear any strain. There have been many devices suggested for separating and joining band-saws, but most of them are unavailable or impracticable. A device, however, has recently been patented which enables the operator to separate the saw, pass it through a hole bored in the wood and join it again, in less time than it takes to disconnect the blade of a jig-saw, pass it through the wood and connect it again to the machinery. This arrangement gives the band-saw an important advantage over the jig-saw in its own special province, as it renders it possible for much thicker material to be sawn than could be done with the jig-saw, and the work will be better done in less time.

The junction of the two extremities of the saw is effected by means of a hook or interlocking joint. A portion of the saw near each extremity is reduced in thickness in such a manner that, when the two ends are laid together, the two combined do not exceed the thickness of the remaining part of the saw. Portions of the back and front of the extreme ends are also cut away so as to leave narrow tongues at each extremity of the saw, and these tongues are provided on opposite sides relatively to each other with snugs or hooks. In the thin portions at the extremities of the saw there are formed, at equal distances from the tongues, two longitudinal slits or openings, presenting bevelled or inclined surfaces at the edges nearest the ends of the saw, corresponding exactly to the snugs on the tongues. The opposite edge of each opening is also bevelled or inclined, but at a much more acute angle, so as to form a recess in the side of the saw for the reception of the extreme end of the corresponding tongue, which is suitably reduced in thickness towards the extremity, in order to enable it to be well within the said recess.

In order to set up the band-saw, that is to say, to join the two ends together, the two tongues are introduced simultaneously into the two corresponding openings, and the ends of the saw are pressed together laterally in such a manner as to cause the snugs on the tongues to engage with or hook on to the bevelled edges in the openings, and the thin ends of the tongues then lie in the inclined recesses in the sides of the saw. When the parts are in this position the two extremities of the saw cannot be separated either by a considerable strain in the direction of its length or by a diminution of the tension.

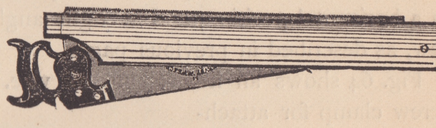

Fig. 62.

In order to disconnect the ends of the saw, it is simply necessary to separate the hooked and bevelled edges by applying lateral pressure, and at the same time drawing the ends apart in opposite directions.

Aids to Saw-Filing.—The following illustrations and descriptions show some of the aids to saw filing in general use.

For filing hand-saws thousands of workmen adhere to the time-honored custom of using wooden clamps, and holding the saw and clamps between the jaw of the bench-screw. Doubtless, this is a ready and economical method and will always obtain in some localities. Fig. 62 shows a saw and clamps ready to place in the grip of the bench-screw.

These clamps may be made of pine, but had better be of hard wood. The end next the point of the saw may have a heavy wood screw in it as shown in the drawing. The pieces forming the clamp should not be less than three inches wide and from seven-eighths to one and a quarter inches thick, and have the upper edges chamfered or rounded off, as shown in the section at Fig. 63.

Fig. 63.

It will be seen that the edge of the saw, having the teeth, stands above the bevelled edges of the clamps some little distance; this is to allow of the file being used with the handle hanging downwards towards the operator, when the saw is a cross-cut one. If the saw being filed is a rip-saw, the file should be held in a horizontal position, and at right angles with the blade of the saw, as described in previous pages.

Fig. 64 shows an iron clamp or vise. It has a malleable iron screw clamp for attaching it to the work bench, and a lever and cam for holding it in any position to which it may be adjusted for convenience in filing, or in a more favorable position for light. It is made so as to spring or strain the saw, preventing vibration, and effecting a saving in files, and is a very effective device for holding a saw while filing.

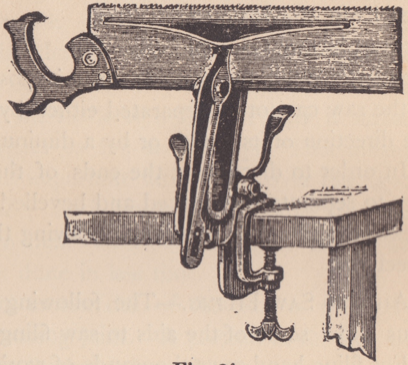

Fig. 64.

At Fig. 64 *a* another clamp is shown. This is known as Wentworth's Patent, and is an excellent device for holding a saw, and particularly adapted for the use of amateurs, as it is simple, durable, and easily handled. The saw can be placed in the grips or jaws almost instantaneously and as readily removed, and may be slipped forward or backwards in a moment, at the will of the operator. The annexed illustration exhibits the device, and will give the reader some idea of the working and character of the tool. In the cut the saw is shown in position, gripped tight and ready for filing. The clamp is attached to the side of a work-bench, table, or side of a wall below a window, by means of strong screws, and it may readily be taken away if not convenient to leave permanently in position.

The clamp is worked by means of a cam, to which a lever is attached, all of which is shown on the lower part of the cut. The

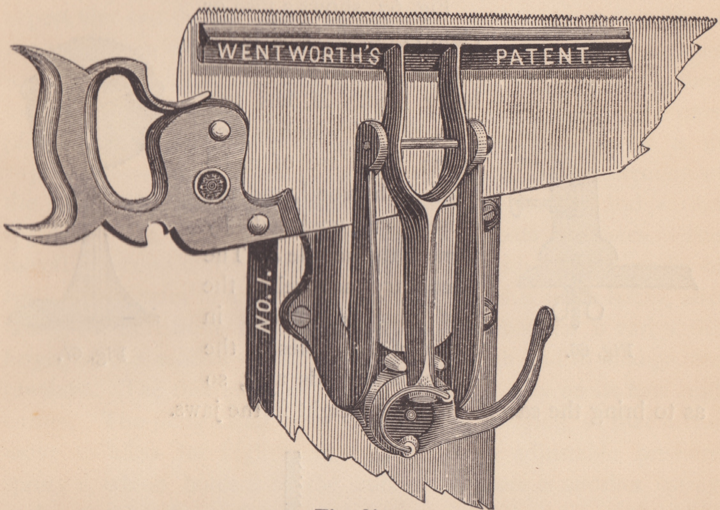

Fig. 64 *a*.

cam attachment is convenient and handy to work, and is efficient as it is simple.

Another style of saw-clamp or *horse* is shown at Fig. 65. It is taken from "Knight's Mechanical Dictionary," but was known to workmen many years before that work was published. The standards *a a′* are hinged together, and are spread apart so as to open the jaws *c* at the upper end, in order to hold the saw. This is pinched tightly by pressing down the treadle *b*, which forces the feet apart and shuts the jaws.

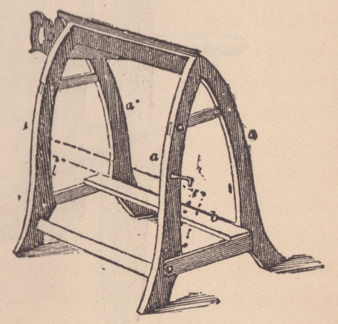

Fig. 65.

Fig. 66 shows another style of clamp suitable for a bench or

work-table. This is a very handy and effective clamp, and is admirably suited for small carpenter or cabinet-shops.

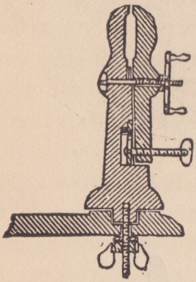

Fig. 66.

Fig. 67. shows a vise or clamp designed for holding a circular-saw while being filed. *A* has two jaws, one of which is seen at *a*; they are of metal lined with wood, and are closed or unclosed by turning the handle *b*. The temporary mandrel of the saw may be placed in either of the holes of the clamp standards at *c*, so as to bring the saw to the right height in the jaws.

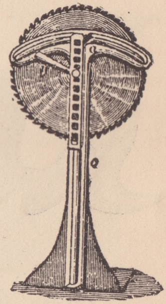

Fig. 67.

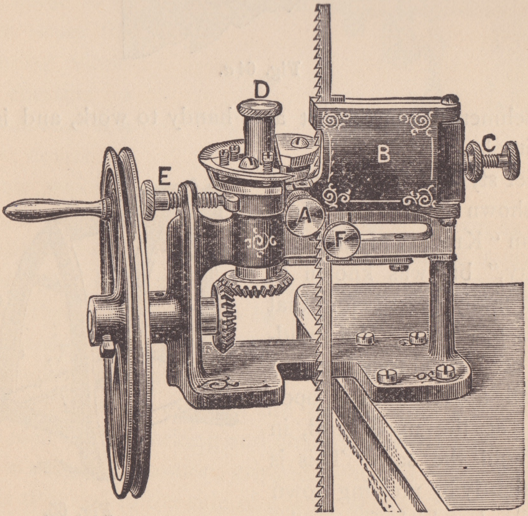

Fig. 68.

At Fig. 68 is an illustration of the *Amesbury Band-Saw Filing*

Machine. Any boy who can turn a crank can file a band-saw with this machine in from five to ten minutes, more accurately than an expert filer can do the same by hand in one hour. It also keeps the teeth even and level, and enables the saw to do more and better work with much less strain than if filed the old way. The machine may be fastened to an ordinary bench, with the saw hanging over (if the work is not done while the saw is in place). The file is in two sections—one stationary, the other movable in the direction of the axis. The stationary section carries the feeders, and a thin segmental file, which latter files only the throats and faces. The movable section carries a thick bevelled file with varying grades of teeth. It rotates in a higher plane and files the tooth-backs, also taking the burr from the points. The thumb-screw D varies the height of this section to suit the grade of teeth and to change the pressure. The thin face and throat file is cut only on its face and corner. The filing head runs in an oblong bearing, so that it can move to allow for high teeth. There is an adjustable pressure spring E, which holds it to the work; and there is another spring under the head keeping it to the tooth-face, thus giving the high teeth the most pressure, and bringing them down to the general bevel.

The saw is held in a clamping-jaw, with the back resting against the gauge F, which is adjustable to any saw width by the screw C, and can be set at any angle. The clamping-jaw is operated by a cam on the hub of the gear, and opens and closes as the machine is feeding or filing. This jaw acts like a vise upon the saw when the files are in contact with the teeth, and releases it when in contact with the feeder.

The filer will work on saws from one-sixteenth of an inch to two inches in width, and on saws having from two to twenty teeth to the inch.

Besides the filing machine shown at Fig. 68, for filing band-saws, there are several others that possess special merits of their own, one of which is made by Fay & Co., of Cincinnati, Ohio, and another by Pryibil & Co., of New York City.

The best guide for hand-saws that the writer knows of is made

by Roth & Bro. Its action may be gleaned from an inspection of the engraving shown at Fig. 69. It is very easily worked, and by a little ingenious arrangement can be used for filing circular as well as straight saws.

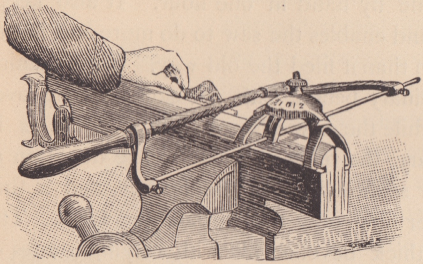
Fig. 69.

In the cut a hand-saw, or other kind of saw, is held in a wood clamp made as shown. There is a circular plate having figures on its upper side agreeing to a scale marked on its edge, that are for setting the file to a bevel for either side or square across a saw. Legs extend from the plate over the clamp into grooves, as shown in section at end of the clamp. On the under side of the plate are a number of grooves (not shown in cut) agreeing to the scale on its edge, into which a raised rib on the arched piece mashes and is held in place by the thumb nut shown on the top of plate. Through the ends of the arched piece slides a rod, to which are secured by screws the arms which carry the file. By loosing the thumb nut on the top of the plate, the file is readily changed to any desired bevel, and the handle of the file may also be lowered, if desired. The file being set on its bevel, is securely held by the thumb nut on top of the plate, and on the pitch is held by set-screw in the socket of the arm at file handle. The rod, sliding in the arched piece under the plate, guides the file so that each tooth will be filed to the same and equal bevel and pitch, and each tooth will be of equal size when filed to a sharp point, while the action of the file is free and its cutting equal at the point as well as at the heel or large end, and will file a saw equally well whether it is full, hollow, or straight on its edge; will also file circular saws to perfection by the use of a proper clamp. A table connected with this filer is arranged and figured for giving the required bevels and pitches for the kind of saw to be filed, and it is only necessary to set the bevel and pitch as given, and the filer

is ready for use. As the filing is proceeded with from tooth to tooth the guide follows, giving the same bevel, pitch and size to each tooth, thus leaving the saw when finished filing so that each tooth will do its share of cutting equally throughout the entire length of the saw, cut straight, smooth, and very rapidly. The operation of filing does not tire the eye. In the table given with each filer are arranged such bevels and pitches as are known by experience to give the best cutting angles to teeth of the various kinds of saws. The whole art of how to file a saw is combined in this filer and the table connected with it. No special files are required; this renders the machine more valuable.

There are other filers in the market for hand-saws, all of which have special merits.

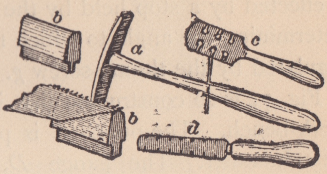

Fig. 70.

Saw-Sets.—These are as numerous as blackberries in berry time, some of them good, some of them indifferent, and some perfectly worthless. There is no set for a hand-saw that will give as good satisfaction as the old-style hammer set, when in the hands of an expert "setter."

The annexed engravings, which are mostly taken from Holtzapffel's work and from Knight's "Mechanical Dictionary," show a number of "sets" of various kinds and forms.

Fig. 70 shows the kind of hammer, *a*, the sawmaker generally employs when setting hand-saws. The saw being laid nearly flat, with its teeth along the ridge of a rounded-edged anvil or stake *b b* held in the tail vise; the angle is in great measure determined by the curve of the stake, which is, for fine-toothed saws, considerably pointed. Half the teeth having been bent, the saw is turned end for end, and the intermediate teeth similarly treated.

The sets *c d* are commonly employed by the users of saws, requiring less skill to give the proper inclination to the teeth—*c* is used for large, and *d* for small saws. They consist of narrow blades of steel, with notches of various widths, to accommodate

different thicknesses of blades. The saw is held between clamps, the alternate teeth inserted a little way into the notch which they most nearly fit, and bent over to the proper angle by pressing the handle of the tool; the operation is then repeated on the intermediate teeth.

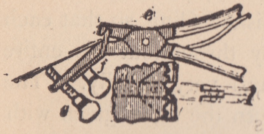

Fig. 71.

Sometimes saw-set pliers *e*, Fig. 71, are used. These require two adjustments: one for setting the jaws to the thickness of the teeth, which is effected by a stop held by the thumb-screw *f*; and the other for determining the angle to which the teeth shall be bent, which is regulated by the thumb-screw *g*.

Fig. 72 is so constructed that it may be stuck in a hole on the work-bench. The punch *C* is pivoted to the stock, and is struck by a hammer. The gauge *D*, against which the points of the teeth rest, graduates the position of the saw in accordance with the length of the teeth and in relation to the hammer. The blade rests on *H*, whose vertical adjustment determines the degree of *set*.

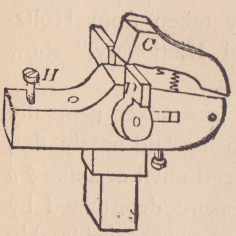

Fig. 72.

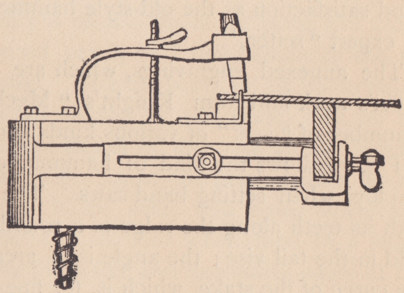

Fig. 73.

Fig. 73 is another form of bench implement, in which the punch is placed in a socket of the adjustable spring. The saw-rest has an inclined lower side, and the brackets vary in elevation to suit, so that the rest can be moved endways to alter its elevation and the

set of the saw, such movement not destroying the horizontality of the upper edge of the rest.

Fig. 74 shows another set suitable for putting in a bench. It is on the hammer principle, and can easily be adjusted to give the requisite set by raising or lowering the two set-screws.

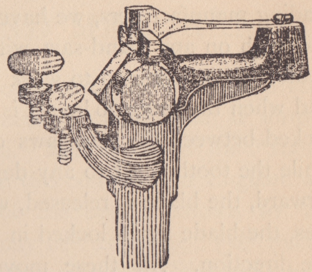

Fig. 74.

Fig. 75 shows a machine manufactured by Goodell & Waters, Philadelphia, for setting band-saws. The makers claim that it will set saws from one-eighth of an inch to two inches in width *accurately*, at the rate of 300 teeth per minute.

The makers say: "It is designed and constructed upon entirely

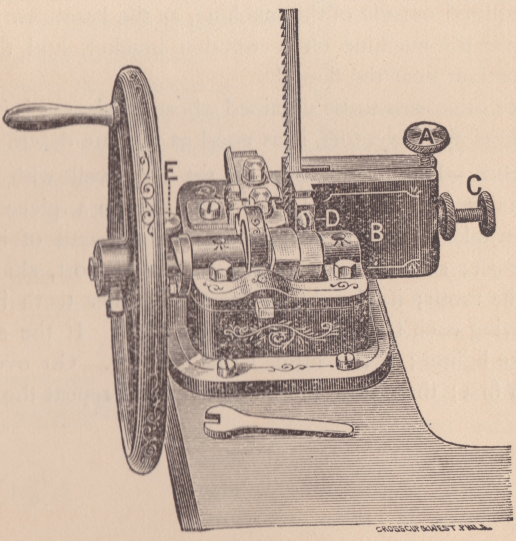

Fig. 75.

new principles, and embodies all the good features of hand-work in

combination with the speed and regularity of machine-work. The users of band-saws have long felt the need of a machine that would hold a narrow saw in a rigid position, and set the teeth without straining the blade; and in response to inquiries from many of our leading manufacturers, we have perfected a machine that will set the teeth on any band-saw without in any manner affecting the blade. It is arranged to work by an easy, uniform crank motion, and when the tooth to be set is fed into position, the blade is firmly locked between the steel jaws of a vise, and remains immovable while the tooth is set to any degree required. As the crank goes forward, the blade is released, when the next tooth is fed up to the dies, the blade again locked in vise, and this tooth set in the opposite direction. All these movements are automatic, and can be carried on at a speed of 300 teeth per minute. The feeder picks up *only the tooth that is to be set*, consequently each tooth is fed to its proper position, *regardless of their irregularity*. No further expense is required outside of the machine, as the band-saw is simply hung up over the machine on a wooden bracket, and the lower part left pendant near the floor."

There are other sets to be obtained whose efficiency, it is claimed by the makers and inventors, is as good as the one described.

PUNCH-SET.—Hand-saws may be set very well with a small punch or nail-set. Place the blade of the saw on a piece of hard wood; then take a small punch, putting the flat end of it on the tooth to be set; strike the top of the punch a short, sharp blow. Examine the tooth; if all right, go over the other teeth in a like manner, giving each tooth the same sharp blow. If the set is too much, strike lighter; if too little, strike heavier. Go over every other tooth first; then turn the blade over and repeat the process.

PART VII.—NOTES AND MEMORANDA.

SAW-GAUGE.—These are of several kinds. One is used for measuring the thickness of blades, and is formed like that shown at Fig. 76. This is called the "standard gauge," and nearly all saws in this country and England are measured by it. The thickness of the saw is known by the number of its gauge. Thus, a saw may be "10 gauge" (1/8″ thick), "18 gauge" (·049″ thick), or any other within the limits of the instrument. This gauge is also used for measuring sheet metals and wires. The engraving shows the instrument one-third the actual size, linear.

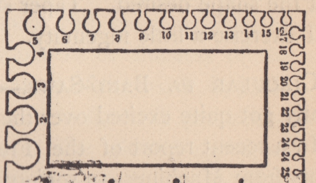

Fig. 76.

At Fig. 77 a depth-gauge is shown on a thin-bladed saw. The handle of the saw forms part of the gauge. This style of saw and gauge is used frequently by comb makers. For cutting kerfs in stuff intended to be bent, a gauge of wood may be made to fit on a back-saw in nearly the same manner as the iron one shown in the figure. Two strips, half an inch thick and one inch wide, and left about two inches larger than the blade of the saw, so as to project over the ends to be screwed together with the saw-blade between. One screw may be loosened whenever the blade is to be inserted, and when the gauge is placed in proper position both screws should be tightened up so that the gauge will remain where it is placed. The distance from the point of the teeth to the gauge should be the same as the depth of the kerf.

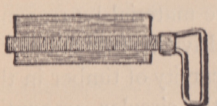
Fig. 77.

SAW-GUIDES.—Every workman is supposed to know all about the mitre-box, which is probably the saw-guide that is most used of any. Almost any angle may be laid off in a mitre-box, and when cut, the saw-kerfs made will act as guides to keep the saw in the proper direction. The fence on the circular-saw bench is a guide. It should never project past the centre of the saw unless the stuff being sawed is cut into very thin strips. More harm is done to small circular-saws, by having the fence too long, than many persons are aware of. A saw-guide of this kind should be made of hard wood—the harder the wood the better the guide—as in my experience it works better than a guide made of iron, and there is no danger of injuring the saw with it by crowding it against the blade of the saw while the latter is in motion. There may be guides so arranged on circular-saw benches that bevel stuff may be cut to just the shape desired. Taper stuff may also be cut if the operator will exercise a little ingenuity.

CIRCULAR *vs.* BAND-SAWS.—France and Germany have recently got quite excited over the question of saws.

In a recent report of the French Society for Preventing Accidents from Machines—a society founded under the auspices of the Société Industrielle de Mulhouse—a recommendation is made for the avoidance of the use of circular-saws in all workshops, where practicable. The following are the reasons for this recommendation:

"1st. Circular-saws are dangerous to workmen; 2d, they require more power than other saws; and, 3d, they cut a broader line, and are consequently more wasteful."

The Germans say that the time-honored circular-saw must give way to the band-saw. Besides wasting more material by reason of wider kerf, and requiring more power to drive it, the circular is more dangerous than the band-saw. The scarcity of timber in that country makes the saving of the band over the circular, amounting to fully twenty per cent., an item worth looking after.

There is no doubt about the band-saw being the proper machine to use in factories and shops for general purposes, but for the manufacture of lumber, the circular-saw will long remain the most popu-

lar, as it is the most profitable saw used in this country. There are certain kinds of work requiring to be done in wood-working factories that can not be accomplished with a band-saw, such as rebating, ploughing, grooving, and cross-cutting long stuff, that may be done with a circular. For general purposes in a wood-working factory I strongly recommend the band-saw, but I fully recognize the necessity of having, at least, one circular-saw bench in every shop. Band-saws are now constructed so as to cut on a bevel or cant, and the tables are made so that they tilt in any direction or bevel. This increases the usefulness of the saw very much.

Emery Sharpeners.—In sharpening saws by means of emery wheels or discs, it will be found that the speed at which the wheel is run has much to do with its cutting action. An emery wheel of good quality should have a grit hard and sharp enough to cut almost any material, but the coarseness or fineness of the grit should be varied according to the nature of the work in hand. A speed at the periphery of from 4,500 ft. to 6,000 ft. per minute will be found suitable for most purposes. The slower speed will be found most suitable for small wheels, say up to 12 in. diameter. Above this size the speed at the periphery should be increased in ratio to the diameter of the wheel, say 100 ft. extra speed for every inch increase in diameter. If wheels are run at too slow a speed, their cutting action is much impaired, and good wheels have sometimes been condemned from this cause, although it must be admitted that there are many wheels of inferior quality sold. When circular saws of small diameter only are used, I should not advise the use of emery wheels, unless they are used for gumming or enlarging the throats.

Small Saw.—The smallest circular saw in practical use is a disc about the size of a five-cent piece, being employed for cutting the slits in gold pens. They are about as thick as ordinary paper, and make 400 revolutions per minute, this high speed keeping them rigid, notwithstanding their extreme thinness. Circular saws for cutting metal have been known for nearly two hundred years.

MACHINES.—For many years the French excelled in the manufacture of band-saw blades, the English in the manufacture of circular and all kinds of hand-saws. Now, however, we make in this country the best circulars in the world, and as good hand and band-saws as either the English or French. In the machines, however, we are far in advance of either the English or French, and our band-saw machines and circular-saw benches may be found in every country in the world, and as yet no foreign maker has been able to approach the American machines in beauty or efficiency without stealing our patterns.

NARROW SAWS.—All narrow saws, having a handle only on one end, should have the teeth so formed that they point towards the handle, or, in other words, the saw should do the cutting on the pull stroke. Oriental saws are all made to cut on the pull stroke, and it has often been recommended by modern writers on this subject that all our narrow saws be made to work on this principle.

Holtzapffel, I believe, was the first person who made the suggestion, though several other persons, I notice, lay claim to having brought the matter to notice. Doubtless, after awhile, saw-makers will see that it will be to their interest to make key-hole and other like saws as they ought to be.

BRAZING BAND-SAWS.—In towns and cities where gas is used for lighting purposes, it is often employed for brazing band-saws, and nearly in every case where this is done, the blade of the saw operated upon becomes deteriorated, and the breakages gradually increase in number. A recent writer on this subject says: "As these breakages do not occur exactly at the joint, no blame is attached to the use of gas, and the cause of continual failures is rarely, if ever, discovered. It is well known that a gas flame not only scales steel deeply, but also destroys the nature by burning the carbon out, and this occurs specially at the edge of the flame. Band-saws brazed by gas almost invariably break again at a point some little distance from the previous fracture, at the point where the outer edge of the flame has damaged the metal. A large proportion of the users seem to be completely puzzled as to the

method of repairing easily. The only really satisfactory way is to make a thick, heavy pair of tongs bright red-hot, and clamp the joint with them. The heat melts the spelter instantly, and makes a good joint without scaling or damaging the steel. For a joint which has to stand constant heavy strains and bending, it is better to use an alloy of equal parts of coin-silver and copper, melted together and rolled out thin. This alloy never burns, cannot be overheated, and makes first-rate joints, which will stand hammering and bending to almost any extent."

REMARKS ON CIRCULAR-SAWS.—The following remarks, which recently appeared in a foreign journal, are applicable here, and may be read with profit by many of our practical sawyers:

"Many of our preceding remarks on saws and saw-teeth will apply equally well to circular as to straight-saws, and it is quite as important that the teeth of circular-saws to do good and effective work should be: 1, teeth of the correct shape for the nature of the wood sawn; 2, teeth correct and equal in pitch, space, bevel, gullet, length, and set. This list may appear somewhat formidable, but users will soon find that any reasonable amount of time spent in keeping saws in fine condition, and working them in what may be called a scientific manner, will rapidly repay itself.

"Owing to the speed at which the teeth of circular-saws are made to run, the cutting action of the teeth on the wood may be considered practically continuous; therefore, to allow of more space or throat room for the clearance of the sawdust, the teeth are set further apart than in reciprocating or mill-saws. They are also made more inclined, and are set coarser. The circular-saw has the disadvantage of requiring large power to drive, and it also wastes a considerable amount of wood. These drawbacks are, however, more than counterbalanced by its ready adaptability and speed in converting all kinds of wood.

"Before commencing to sharpen a circular-saw, care should be taken that it is *perfectly* round. This can be done by placing the saw on the spindle, and running down the points of the projecting teeth by means of a hard piece of stone.

"It has of late become somewhat the practice to decrease the

number of teeth in the periphery of circular-saws, and we are rather inclined to favor this, as more throat space is given for the clearance of sawdust, and less power is required to drive, unless it is carried to excess, as it has been in some cases, where large saws, carrying only eight teeth, have been run, and in one case in California, a saw, euphoniously called the "Woodpecker," with only two teeth, is or was in operation. In the successful working of circular-saws much depends on the speed of the saw-teeth being suitable to the material operated on. The writer has tested this on various timbers, and with different kinds of saws, by placing a four-speed cone pulley on the saw-spindle in lieu of the ordinary fast and loose pulleys. This arrangement, however, would necessitate a considerable alteration in the machines and shafting at present in use, and the same effect may be gained by using different diameters of saws; the improvement in the sawing with varying speeds was very great. Thus, in sawing oak and other hard woods, the speed of the saw-teeth and feed were both reduced with marked advantage, the teeth at same time being more in number, smaller in size, and more upright in position, whilst in the case of cross-cutting, when the action of the saw is essentially a cutting one, the speed of the saw can be increased with advantage."

There can be no doubt about there being too many teeth in the modern saw, as generally used, for ripping purposes; and I am satisfied that if two-thirds of the teeth now employed were dispensed with, the same amount of work would be turned out with them as now, but with less labor, and the saws would be kept in better order at half the expense.

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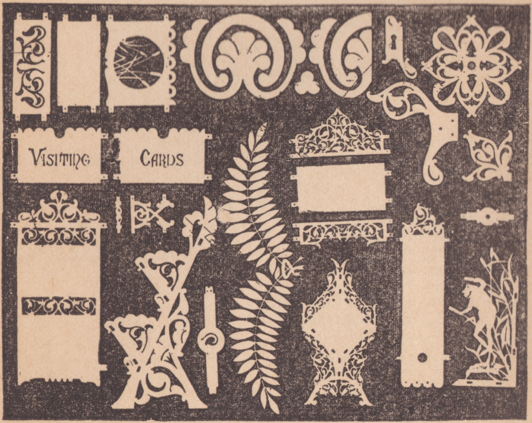

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